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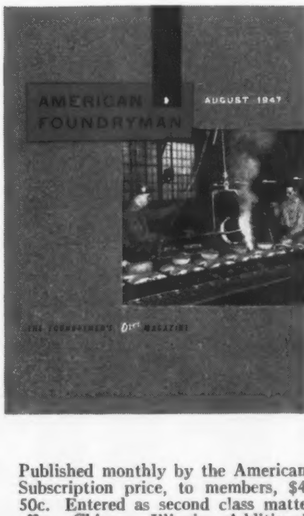

This Month's Cover

Conveyorized pouring station in the brass foundry of the H. B. Salter Mfg. Co., Marysville, Ohio. In two-shift operation, the battery of four fully automatic furnaces melts over 5 tons of metal per heat . . . 225 pounds of metal poured every 3½ minutes.

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THE GROWING IMPORTANCE OF THE PATTERNMAKER

ADVANCEMENT of the foundry industry is largely dependent upon the skill of the experienced patternmaker. High production demands, with a consequent increase in foundry mechanization, and more rigid specifications for dimensional accuracy in many types of castings, have greatly added to the responsibilities of this craftsman.

That duplication of parts can be achieved better, and accuracy more readily maintained, when made on molding machines, core blowers and other machines, is well known. The experienced patternmaker, who has had close connection with a modern foundry is one of the best fitted individuals to supervise the making of equipment and rigging it for high production with dimensional control.

Regarding the future, may I emphasize the importance of training more patternmakers. All jobbing and captive shops, where patterns are made, should have a well established apprentice training program to take care of future requirements in this field. We do not have the number of skilled patternmakers necessary to take care of the work essential to our industry.

As an incentive to create more interest in the apprentice program, the American Foundrymen's Association sponsors a contest each year, both in molding and patternmaking. A greater response was noted in the patternmaking contest this year inasmuch as the A.F.A. increased the amount of the awards, which made it well worth any apprentice's efforts to participate, in addition to the pride of personal achievement.

A closer relationship between patternmakers and men in the foundry would make for better qualified patternmakers. This applies primarily to patternmakers who obtained their start in a trade school or a job shop, which is somewhat removed from the actual foundry operation. Much can be gained by knowing the requirements of the people who use the equipment made by the patternmaker.

May I also suggest to those who are not members, much can be learned through affiliation with the American Foundrymen's Association. Considerable knowledge can be obtained by attending chapter and national meetings, since the best qualified persons in the industry give technical lectures on all the different phases of foundry practice.

The time worn phrase that "A casting is no better than the pattern equipment from which it is made," holds true today just as much as ever. We of the patternmaking industry have the responsibility of upholding and maintaining a standard that will be above reproach.

J. E. Kolb

J. E. KOLB, *National Director*
AMERICAN FOUNDRYMEN'S ASSOCIATION

J. E. KOLB, superintendent of the pattern shop, Caterpillar Tractor Co., Peoria, Ill., has held membership in A.F.A. for a number of years. A prominent speaker at various A.F.A. chapters and regional conferences, Mr. Kolb attended Bradley Polytechnic Institute, Peoria, and has been affiliated with Caterpillar for more than 30 years.

ABRASIVE BLASTING OF CASTINGS

R. L. Orth
District Sales Engineer
American Wheelabrator & Equipment Corp.
Detroit

Any discussion of abrasive blasting of castings may well be initiated by attempting to define the process and examining the purpose of the operation. In simplest terms, castings are blasted to remove the mold elements that stick to the internal and external surfaces, as well as the scale that is formed by oxidation when the molten metal comes in contact with the mold or through subsequent annealing and heat treating operations.

Blasting of castings offers many advantages:

1. Parts come true to pattern and can be cast closer to ultimate dimensions—less machining required.
2. Castings entirely free of sand and scale machine more easily and at greater speeds.
3. Cutting tools last longer and do not require grinding as frequently.
4. Prepares a perfect surface for clading processes—enameling, painting, metallizing, galvanizing, plating, and rubberizing.
5. Makes inspection easier and more accurate. It is good economics to catch the defects quickly so that defective castings can be scrapped at minimum cost.
6. Appearance—well cleaned castings are more desirable to handle and have more "sales appeal."

Blasting Equipment Classified

The blast equipment that is in commercial use today can be broadly divided into two general classifications: (1) Nozzle equipment in which compressed air, water or steam is employed in hurling the abrasive against the work, and (2) airless or mechanical wheel type of equipment in which the principle of centrifugal force is utilized to propel the abrasive.

Cleaning furnace castings in multiple-table (four 66-in. dia. tables) wheel-type blasting machine.

A more specific classification can be made on the basis of the mechanism used for holding the work in or conveying it through the blasting zone.

Both the nozzle and wheel types are more or less standardized into the following designations: (a) rooms or booths; (b) barrels; (c) tables, and (d) special cabinets.

The airless or wheel-type equipment has certain advantages in greater cleaning speed, lower power consumption and, on an equal capacity basis, reduced floor space requirement.

During the past 10 or 12 years this economic advantage has resulted in numerous installations of the wheel-type equipment. However, the small air blast hand cabinets, blast rooms with inside operators, and special automatic air machines all have their applications, and in some cases represent the most economical, if not the only solution to the blasting problem.

Selecting Proper Equipment

The basic types of standardized equipment, i.e., rooms, barrels, tables, and special cabinets, are built in a wide range of sizes and designs to meet various requirements. These basic types have certain fundamental characteristics in common. In each case are:

(a) A blast chamber for confining the process.

(b) Mechanism or device for holding and exposing surfaces of work during the operation—sometimes this is combined with a mechanical method of conveying work into, through and out of the blast chamber.

(c) Equipment for hurling concentration of blast onto the work.

(d) System for reclaiming, cleaning and storing spent abrasive.

These features take various forms with the different designs.

Many factors must be taken into consideration in picking the machine for any specific job:

Cleaning malleable castings in tumbling and blasting machine equipped with skip bucket loader.

Cleaning aluminum castings on a 6-ft blasting table.

(a) General shape, size, and weight of castings.

(b) Condition of castings at time of cleaning, i.e., before or after gates are removed, whether cleaning is done on the "as cast" or heat treated work, etc.

(c) Production.

(d) Work handling methods employed to bring castings to cleaning equipment and for carrying it away from the operation.

(e) Building limitations as to floor space, ceiling height, etc.

(f) Analysis of present or proposed future cleaning equipment and needs in effort to integrate new equipment into over-all requirements.

In most cases, any one of several sizes or designs of equipment will satisfactorily clean the work under consideration. In general, the high production, automatic designs will clean the work at lower cost on a per ton or per piece basis, but the initial investment is higher.

Many problems are so clear-cut that there is no difficulty in choosing the equipment. Some cases are borderline, however, and in these a careful analysis must be made in selecting a machine that strikes a reasonable balance between initial investment and operating cost.

Operating the Equipment

Careful experiment and time study, either in the equipment manufacturer's laboratory or in the plant, should form the basis for establishing standards on any machine as to production rate, cleaning time and finish.

The term "finish" has several meanings and is subject to so many interpretations that an entire paper could not encompass all of the aspects. For our purpose it is sufficient to suggest that the control of the "finish" on castings does not really start in the cleaning room. Finish control is first in the hands of the molder and much depends on the sand, facing, ramming, pouring, and other steps which precede the blasting operation.

A comparatively new design of wheel-type blasting equipment. Swing table is 86 in. in diameter.

Blasting, then, is only one of several operations which affect the "finish" and, although many casting defects come to light during this operation, but few can be charged to the process itself.

The most economical and satisfactory operation of blasting equipment can be obtained only if due consideration is given to maintenance, use of proper abrasive and ventilation. It is doubtful if any other type of equipment used in the foundry requires the repair and care that efficiently performing blast machines must have. The good blast machine is a paradox—characteristically self-destructive. The speed with which it wears itself out is, in a sense, an index of its ability.

Theoretical calculations indicate that a particle of steel abrasive, of the G-40 grit size, flying from a nozzle or wheel at a speed of 250 ft per sec exerts a crushing force of something like 10×10^6 psi. It is not surprising that the blast machine wears out. In fact, it is really surprising that the equipment holds up as well as it does.

Equipment manufacturers are constantly searching for new designs and materials—the first in an effort to confine the blast to the surfaces of the work to be cleaned, and the second to develop wearing parts that will withstand the stray and ricochet abrasive action.

Regularly scheduled inspection, adjustment and maintenance pay dividends. The vulnerable or rapid wearing points of blast equipment generally are protected from the abrasive action by multiple wear plates. The top plates or guards are the first line of defense, and should be replaced before they are worn through. The secondary plates are the "safety factors" and serve the purpose of protecting the blast chamber outer shell or the vital mechanism in case the primary plates break through between inspections.

Only by carefully watching the primary guards and replacing them at the proper time can costly down time and major repairs be held to a minimum. Unless actual experience proves another course more economical, replacement parts should be purchased from the machine builder or made of the material recommended by him.

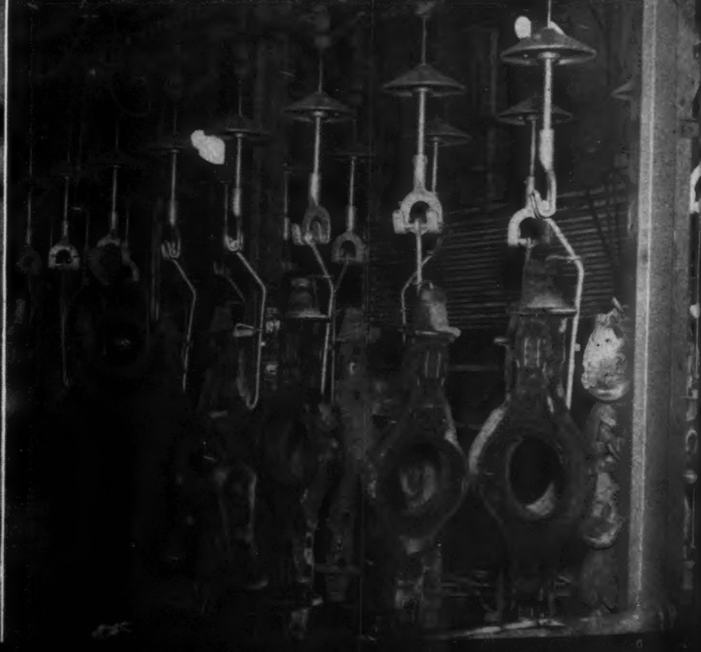
Hard surfacing materials, alloy steels, rubber, etc., have their uses and possible applications. However, it must be remembered that there is more to determining the suitability of these special materials than merely comparing the cost/life ratios. The cost/life ratios can be improved in some cases by making the part of material that is harder or more resistant to abrasion than that used by the manufacturers. However, as a rule, the lower cost/life is more than offset by the increased abrasive cost brought about by the more rapid breakdown of abrasive against the harder wearing plate.

The direct operating cost of any blast machine is made up of replacement parts, maintenance labor, abrasive, power and operating labor costs. Parts, maintenance labor and abrasive costs are so interrelated that a change made in an effort to reduce any one of them must be evaluated in light of the effect on the other two, and unless the sum total is lowered no improvement has been effected.

Selecting Abrasives

Probably no other phase of the process comes in for as much discussion and disagreement as the selection of the proper abrasive for any machine or any particular job. Although blast machines are operated with such abrasives as crushed corn cobs, crushed apricot

Left—Cleaned cylinder castings emerging from monorail blasting cabinet. Below—axle housing castings in wheel-type monorail blasting cabinet.



pits, clover seeds, and a host of other natural and synthetic abrasives, the foundry industry has little use for any other than silica sand and metallic abrasive.

Much of the foundry blasting is now done with what is termed "steel" shot or grit. The differences of opinion stem from the selection of shot or grit, and the size of either to be used for a specific application.

Special Finishes

There are some applications where grit is definitely required—for example, the preparation of stove plate castings for enameling. Here the object is to produce a clean and well "cut" surface for securely anchoring the enamel. In other cases shot gives better results, but the vast majority of applications can be served equally well with either shot or grit.

It is argued that, since the abrasive breaks down into smaller particles with use, the larger sizes are more economical. To a certain extent this is a logical basis for making a selection, although it is equally true that the very large sizes (say above S-490) will not clean as rapidly as the smaller material. Furthermore, it should be remembered that the abrasive particle size definitely affects the rate of wear on the equipment and, in general, the larger the particle, the faster the wear rate.

Here, again, the overall operating cost must be the determining factor and the effect of abrasive size on the balance of the total cost need to be carefully weighed. While it will not hold in every case, the operator would, more often than not, do better to select the smallest size of abrasive that will do the job and still permit satisfactory removal of sand and scale fines.

Ventilation of blasting equipment is of particular importance. The purpose of a good ventilating system is to (a) remove the float dust created in the blasting chamber, elevator, screw conveyor, enclosures, etc., and (b) separate the foundry sand, scale, and non-usable fines from the abrasive. It is simply "good housekeeping" and an enhancement of the operators' efficiency to make the machine as free from float dust as possible.

Removal of sand, scale, and useless fines from the abrasive is absolutely essential for the most economical operation of the equipment. Sand-contaminated steel abrasive increases the wear rate drastically on nozzles and mechanical wheel parts. For example, the wear rate on blades in a centrifugal wheel throwing sand is five or six times that on blades in a wheel which is handling steel abrasive of the same particle size.

Improper ventilation allows the sand and fines to build up in the abrasive and results in longer cleaning time, higher equipment maintenance, undesirable operating conditions, and leaves a deposit of fine dust.

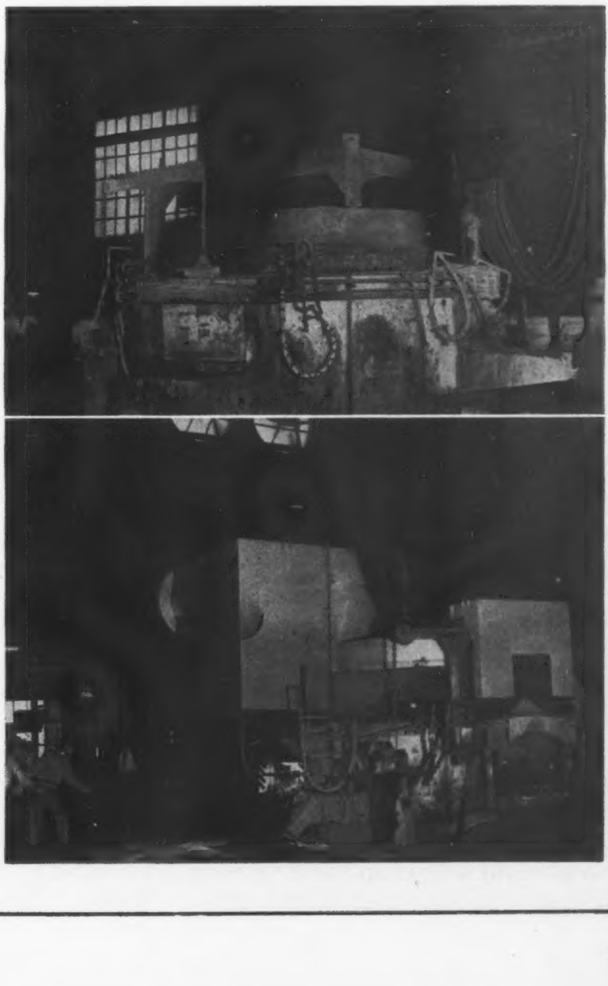
Modern blast machines are designed with integral abrasive separators which, when properly adjusted and maintained, will automatically keep the steel abrasive free of sand and contaminations.

VENTILATION OF ELECTRIC FURNACE

EFFECTIVE SMOKE, dust and fume control from the 12 ton Heroult side charge electric melting furnace at Rustless Iron & Steel, Baltimore, Md., has been obtained by the application of an exhaust hood. This hood employs the engineering principle of placing adequate material at the point of generation, preventing its dispersion to the melting room and immediate foundry area.

The hood essentially consists of one section mounted on the lintels over the charging door with a second section attached to the roof ring. Sufficient openings are provided around the electrodes and over the charging and slagging door to maintain an indraft at those points adequate to draw all generated materials directly into the exhaust hood. Collected materials are then conveyed to a wet type dust collector before the clean air is discharged to the atmosphere.

Hood construction permits rapid removal to facilitate changing of furnace roofs and provides a positive means of smoke control with only a fraction of volume of the exhaust used where general ventilation is applied. Visibility of crane operators also is greatly improved.



Top—Typical smoke condition at the electric furnace before the installation of the local hood and (below) after the hood was placed over the furnace.

PREVENTING SHRINKAGE IN GRAY IRON CASTINGS

Tellurium Corewashes as Chill Inducers

W. P. Sullivan
Metal Control Supervisor
Warden King Ltd.
Div. of Crane Ltd.
Montreal, Que.

IT IS AN ACCEPTED FACT that porosity or voids in a casting can be effectively eliminated by means of proper gating, feeding, and chilling.[1] This paper will deal exclusively with the application and beneficial effects of a tellurium-base corewash in avoiding one of the most troublesome defects in the gray iron foundry with which the author is associated. It is not the author's intention to delve into the theoretical phase of this subject, but rather to assemble the results of experimental work in so far as they provide selective control in a highly productive foundry, and above all as a reject preventative.

On all front sections and on a back section of the square-type boilers (Fig. 1) hinge inserts are present at different locations; as many as eight of these are found on some castings. These areas were the source of innumerable rejects—excessive porosity was always the predominant failure.

Non-uniform solidification and intricate design were two factors that could not be entirely overcome, either by specified metal composition, with the resultant physical properties, or by proper gating and feeding of the casting. However, it may be worth noting that the most efficient results were achieved when the physical and chemical properties of the metal conformed to the following specifications:

Chemical Composition, per cent	
Silicon	2.25
Manganese	0.60
Sulphur	0.80
Phosphorus	0.50
Combined Carbon	0.50
Total Carbon	3.50
Physical Properties	
Transverse Strength, psi	2900-3000
Tensile Strength, psi	30,000

The undercut section on the casting lent itself admirably to chilling since it was filled in by a small dry sand core separate from the body core (Figs. 2 and 3). Also, no machining whatever had to be performed around this part of the casting. It was decided that experimentation would be carried out utilizing a tellurium-base corewash as the chilling medium. The application of tellurium to improve the quality of pressure-tight boilers and other pressure castings of this type had been highly recommended.[2]

Since tellurium had been described as a potent element with toxic properties in the volatilized state, all preliminary work was carried out under laboratory supervision, competently assisted by the general coreroom foreman. After considerable practical experience, it can be said that, with ordinary precautions, but little danger is encountered when using tellurium as outlined in the paper.

The tellurium purchased was in the powdered form, 99 per cent pure, the chief source of supply being as a by-product in the electro-refining of copper.[3] The next step was to select a suitable suspending medium so that an even application of the wash would be possible.

Fig. 1—Boiler front section gray iron casting.

Presenting a practical method for the use of tellurium corewashes as a means of selective control in the gray iron foundry, this paper was awarded first place in the Essay Contest sponsored by the Eastern Canada and Newfoundland Chapter of A.F.A. during the 1946-47 season.

Ordinary foundry blacking proved to be what was needed, and was used throughout this period.

Variations and haphazard occurrences were guarded against by closely controlling the weight and amount of all materials used, and by uniformity of method and technique. The general aim was to standardize the particular details so that any change deemed necessary could easily be introduced without permitting error to creep in. At times tellurium does not act as expected; recognizing this fact, it is now considered essential that such steps be rigidly adhered to in order to avoid erratic behavior.

Numerous mixtures were made up with varying percentages of tellurium powder; test pieces were cast with each mixture, fractured, and examined for the depth of chill. When a skin of chilled metal approximating $\frac{1}{32}$-in. was constantly induced, it was decided that the corewash mixture used to produce it was sufficiently powerful. The constituents of this mixture were:

Tellurium powder, grams	400
Foundry blacking, grams	500
Water, qt.	1

Furthermore, behind the de-graphitized portion, in each case the gray iron unchilled by the tellurium reaction was densened to a marked degree.

This process was immediately put into practice under the direct supervision of the coreroom foreman. All hinge cores for the next and subsequent runs of castings were dipped in the prepared solution and air dried. Specific instructions were issued to the boiler division explaining what was being done, the reason for such action and the end intended. Similarly, detailed control was maintained at the cleaning and testing division in order to gather all possible information.

On the first day 50 castings were made; not one section was rejected because of apparent defect at the hinge openings, nor were leaks detected when the castings were put under water pressure. From castings rejected for various reasons, 30 hinges were selected at random and subjected to close visual inspection. When

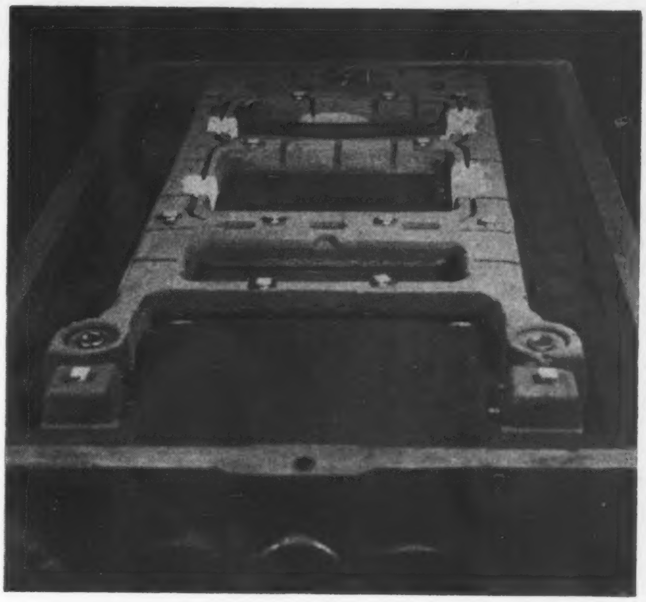
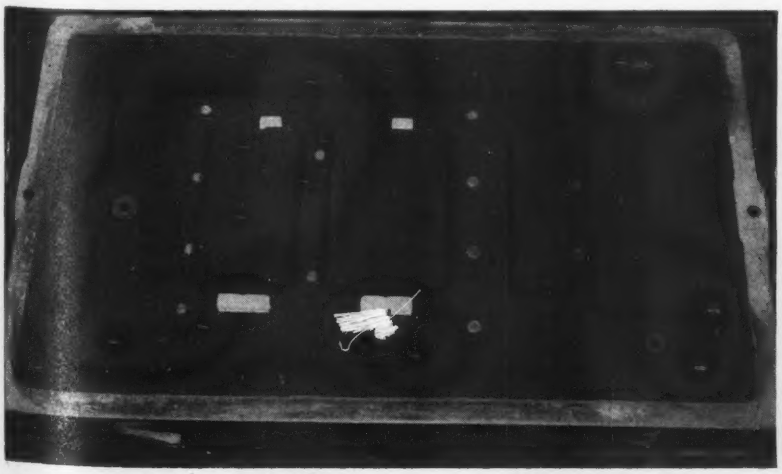


Fig. 4—Body core showing cut-out for hinge core.

broken open not one was found to exhibit any trace of shrinkage. A uniform chill, as stated at the test trial, and the expected densened surrounding area of metal were obtained.

In sharp contrast, during the previous week the same investigation was carried out and, while on almost half of the castings examined there was no apparent shrinkage at the test, it was found to exist in the incipient stage. The encouraging results obtained by the use of the corewash were further enhanced by reports from the boiler machine shop that these castings caused no unusual difficulty in machining. During successive production days every detail was carried out as planned and the results were identical. During one week alone, 373 sections were cast and not one was scrapped due to shrinkage. Tellurium had proved most beneficial and its continued use found to be warranted.

This information is not intended to convey the impression that since beginning the use of tellurium corewash it has not been necessary to reject a section be-



Figs. 2 and 3—Views of mold for boiler front section casting showing hinge cores. The cores are painted white.

cause of a shrinkage defect, but rather that the total number of sections lost from the time this corewash was introduced is practically negligible. When compared to the previous scrap percentages, tellurium has been particularly successful. It has been of tremendous aid during critical times when chemical and physical properties of the metal were difficult to control, caused largely by the shortage of raw materials.

As previously mentioned, some castings did not pass the pressure test even after tellurium was used—on nearly all of these the chill did not materialize or was barely visible. A possible explanation is that the hinge cores were dipped without periodic stirrings to keep the tellurium in proper suspension. The operator must be careful not to dip too many cores without stirring the mixture from time to time.

Two explanations of how tellurium may be introduced into the iron have been suggested by J. O. Vadeboncoeur: [4] "Elemental atoms may diffuse into the iron, or the diffusion of the vapors themselves may be instrumental in uniting the two metals. Conclusive evidence is lacking for either argument, but after observing the gases associated with every experiment conducted on this metal, the vapor diffusion hypothesis was favored."

The pronounced effect of tellurium in the foundry is shown in this paper. As a logical outcome of this project, it was concluded that tellurium corewashes should be given consideration when any portion of a casting is to be chilled. As to pressure-tight castings, such as boilers and cylinders, its role is most promising where no machining is required. In the cases specified, the wash at the present time is considered indispensable, and the ends achieved indicate that it be used permanently. Only through methodical investigation will the potential value of tellurium in the foundry be discovered and assume wider application.

Acknowledgment

The author wishes to express his sincere appreciation to the management of Warden King Ltd. for the constant encouragement and suggestions afforded, and to J. Riley, general coreroom foreman.

References

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2. "Some Initial Results on Influence of Tellurium as a Chill-Inducing Medium in Cast Iron," *Foundry Trade Journal*, vol. 7, no. 1543, Mar. 14, 1946, pp. 283-7.
3. Hillebrand and Lundell, *Applied Inorganic Analysis*, p. 258.
4. J. O. Vadeboncoeur, "Tellurium Corewashes," *Transactions*, ASM, vol. 37, pp. 303-8, 1946.

LIGHT METALS DIVISION NAMES BONSACK AS CHAIRMAN

Officers for the Aluminum and Magnesium Division, American Foundrymen's Association, have been chosen by the division's executive committee and the officers were installed July 1. Walter Bonsack, Manley E. Brooks and J. C. DeHaven are to serve as Chairman, Vice-Chairman and Secretary, respectively, of this A.F.A. technical group.

Walter Bonsack, director of laboratories for National Smelting Co., Cleveland, was named chairman. He is the present division secretary and also serves as head of the reclamation and alloying committee and as a member of the shrinkage and porosity, centrifugal casting and test bars committees.

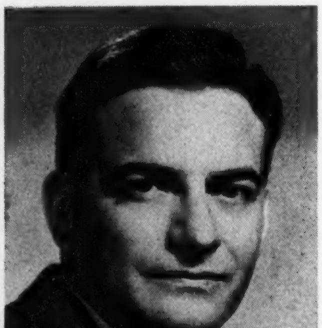
Brooks, Vice-Chairman

Division vice-chairman for the next two years will be Manley E. Brooks, foundry engineer with the Dowmetal foundry of Dow Chemical Co. at Bay City, Mich. A member of the aluminum and magnesium executive group, Mr. Brooks heads the handbook review committee and has also been associated with the division's investigations of sand, centrifugal and permanent mold casting; casting stability; inspection procedures; reclamation and alloying, and test bars.

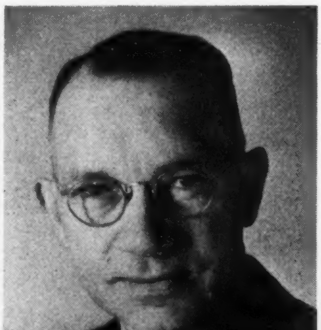
J. C. DeHaven, research engineer at Battelle Memorial Institute, Columbus, Ohio, is the new secretary. He has been chairman of the shrinkage and porosity committee and has served on the centrifugal casting and executive groups.

(Editors note: See the June issue, pp. 48-50, American Foundryman, for information regarding the chairmen and vice-chairmen of the other seven divisions of the American Foundrymen's Association.)

J. C. DeHaven



M. E. Brooks



Walter Bonsack

CANADIAN FOUNDRYMEN GATHER FOR SHERBROOKE CONFERENCE

FOUNDRYMEN OF Canada and United States are being invited by the Eastern Canada and Newfoundland chapter to participate in the Eastern Township Regional Meeting to be held in Sherbrooke, Que., September 12-13, Friday and Saturday, respectively. A great amount of interest already has developed in the forthcoming event and the meeting is expected to attract foundrymen from both countries. Headquarters for the conference will be at the New Sherbrooke Hotel, where splendid facilities are available for every feature of the meeting.

James H. Newman, Newman Foundry Supply Ltd., Montreal, and a director, Eastern Canada and Newfoundland chapter, has been made chairman, program committee. Also serving on this committee are James Grieve and A. H. Lewis, Dominion Engineering Works Ltd., Montreal, committee vice-chairman and secretary, respectively; M. J. Moore, Montreal Bronze Ltd.; Wm. Seeds, Western Pattern Works; W. M. Nuttall, Warden King Ltd.; John McVey, Jenkins Bros. Ltd.; F. Clark, Dominion Engineering Works Ltd.; and W. S. Williams, Canadian Car and Foundry Ltd.

Members of the Sherbrooke committee on arrangements includes: G. M. Young, Canadian Ingersoll Rand Co. Ltd.; R. Neville, Manganese Steel Castings; E. Fisette, Fairbanks Morse Co.; A. F. Patton, Canadian Brake Shoe & Foundry Co.; Wilfrid Legare, Legare Foundry Ltd.; and J. C. Kensella, Union Screen Plate Co. of Canada.

Others aiding the Montreal group include: Chapter Chairman A. E. Cartwright, Crane Ltd.; Chapter Vice-chairman O. L. Voisard, Robert Mitchell Co. Ltd.; Chapter Secretary J. H. Hunt, Dominion Engineering Works Ltd.; and H. E. Francis, Jenkins Bros. Ltd., chairman, publicity committee.

The box below contains the conference program at the time this publication went to press.

IBF Honors Makemson, Gray and Bolton

THE 44TH annual conference of the Institute of British Foundrymen was held June 17-20 at the Albert Hall Institute, Nottingham, England. At this meeting it was announced that the E. J. Fox Gold Medal was awarded to Tom Makemson in recognition of his outstanding services to the foundry industry as secretary of the Institute for 21 years, and also for his work during 1940-46 as Joint Director and later Director of Iron Castings, Iron and Steel Control, Ministry of Supply.

Another award, the British Foundry Medal, was given to Basil Gray, English Steel Corp. Ltd., Sheffield, England. The medal was presented to Mr. Gray as the author of the paper adjudged by the council to be the best presented in the preceding year. The medalist's paper was published in AMERICAN FOUNDRYMAN, June, 1946, and was given at a steel session of the A.F.A. Fiftieth Annual Meeting in Cleveland in May, 1946. This was the twenty-fifth annual A.F.A.-IBF exchange paper.

Announcement was also made at this time that John Bolton was the recipient of the Meritorious Services Medal for exceptional work as acting secretary of the Institute during Mr. Makemson's absence.

John Bolton

Tom Makemson

Basil Gray

Eastern Township Regional Meeting

(Sponsored by Eastern Canada & Newfoundland Chapter)

September 12-13

New Sherbrooke Hotel, Sherbrooke, Que.

Friday, September 12

12:00 pm—Registration

2:00 pm—Plant Visitations

5.30 pm—Entertainment

6:15 pm—Regional Meeting Banquet

8:15 pm—General Session
How to Select a Bond Clay, N. J. Dunbeck, Eastern Clay Products, Inc., Jackson, Ohio.

Saturday, September 13

10:00 am—Steel Session
Speaker and discussion leaders E. F. Vieberg, Turney Shute and Willet Tibbets, Canadian Car & Foundry Co. Ltd., Montreal.

10:00 am—Gray Iron Session
Speaker and discussion leader, E. N. Delahunt, Warden King Ltd., and J. S. Morse, Canadian Ingersoll Rand Co. Ltd., Sherbrooke.

COST CONTROL ELIMINATES GUESSWORK

A timely discussion of the all-important cost factor—presented at a Cost Session of the Alloy Casting Industry Convention, at Hot Springs, Va., June 27, 1947.

Arthur A. Clay
Comptroller
Ohio Steel Foundry Co.
Lima, Ohio

MEMBERS OF THE CASTING INDUSTRY are in business to make a reasonable profit on the production and sale of high-quality castings covering a wide range of analyses, specifications, requirements and purposes. To assure the desired reasonable profit consistently over any stated period of time in such a complex business requires, in the author's judgment, the adherence to certain basic principles, the more important being:

1. There must be a complete understanding of all the requirements of a job before quoting prices and accepting an order; and it must be predetermined whether or not the job fits existing facilities for producing it.
2. Wherever practical, before starting a job, new or old, there must be a definite plan for producing it, plus an accurate cost estimate based on that plan.
3. An adequate cost system must be in use which will enable management to determine whether or not the plan was followed; if not, why not; and, whether or not the actual cost of the job met the estimated cost based upon the predetermined plan of production.
4. Adequate skill, capable management, efficient and balanced supervision and efficient workers.
5. Up-to-the-minute "know-how."
6. Adequate and efficient plant and equipment coupled with modern work methods which assure low cost of operation on production that "fits the existing facilities." Too often, "misfit" jobs are taken with resultant large losses.
7. A monthly budget, variable as to production, income and expense. This budget must be prepared at least 7 to 10 days prior to the beginning of each month, preferably by production centers, and variances therefrom investigated shortly after the end of each month.
8. Castings must be sold both at sufficient volume and adequate prices by a profit-minded and aggressive sales department to realize a fair margin of profit. A price is adequate only if volume is sufficient.
9. There must be co-ordination between all departments of a company, and full and sympathetic co-operation on the part of everyone.
10. Those who are deserving must be rewarded periodically in direct ratio to their accomplishments.

Acceptance of orders from customers with insufficient consideration to the foregoing factors is not in the interest of customer or producer.

Of the many requisites for the making of a profit consistently, the matters of cost predetermination and cost accounting are equally important as the others; yet it is generally recognized today by the members of the casting industry that one of the most neglected things in their business is the provision of a simple, adequate and practical system for accurately estimating costs and fair selling prices by patterns and an adequate personnel to run the system. Like the weather, it is talked about but nothing is done about it.

A wise management of a progressive foundry insures its operating profit by providing itself with accurate cost estimating and cost accounting. It realizes that to make money it must sell its products for more than cost; that it is essential to know the cost by patterns before issuing price schedules or quotations on castings to customers.

By having accurate cost data, by patterns, good management guards itself against (1) the violation of certain basic principles for making a profit by quoting too low and getting a job on which a loss will be incurred, or (2) violation of other basic principles for making a profit by quoting too high and losing to a competitor a job on which it would have been possible to make a fair profit at a lower price had it been quoted on the basis of accurate cost estimates.

Must Know Actual Costs

The small over-all margin of profit existing today in many industries is the result of lack of knowledge on the part of many manufacturers of what their products actually cost to produce and to sell. The casting industry is no exception. The lack of knowledge on the part of some of its foundries today of their actual cost of castings by patterns causes them to issue price schedules and to quote unprofitable prices on many castings which other foundries are in many cases unjustly forced to meet.

Foundrymen in general recognize the importance of accurate and dependable technical information in the management of their plants. They will readily admit that the foundry using modern technical and physical methods has a decided advantage. They are slow, however, to admit that a foundry can have a similar equal advantage by making use of modern cost finding methods.

Experience has demonstrated that it is dangerous to base selling prices of individual castings on an over-

all "scoop-shovel" average cost per ton of castings; yet no single factor in the determination of the cost and selling price of alloy castings has been used more frequently in the past than unsound scoop-shovel company and industry averages. The industry can be thankful that the day of being guided solely by the misleading average cost per ton is rapidly passing. Unfortunately, some members of the industry still are misguided by its use.

Cost Averaging Undesirable

Averaging of costs per ton leads to sad results. Any foundry using the practice will find itself sooner or later in a position of having on hand for production a backlog consisting mostly of unprofitable work. Take for example, the company which uses averages per ton for job cost determination and by this method finds that, over a period of time, its cleaning cost averages nine cents per pound on a scoop-shovel over-all basis, and it uses this basis for estimating the cleaning cost of all jobs.

If some castings are costing 25 cents per pound to clean and others only four cents, a competitor with accurate job cost data will soon let others have the undesirable cleaning jobs by quoting the higher correct prices, and take the profitable low-cleaning-cost jobs by quoting the lower correct prices based on actual costs instead of the inaccurate scoop-shovel averages per ton.

Another undesirable averaging practice, which is gradually being eliminated as more and more foundries become cost conscious, is the "price averaging" of a customer's casting requirements and quotation of an over-all scoop-shovel flat price per pound for everything required. It is impossible to do anything but guess wildly at the average cost of, say, some 50 different patterns. Yet, in the past, such wild guesses were made and the consequences were felt in terms of large losses.

A foundry is encouraging lazy management and inviting trouble when it quotes such flat prices. Obviously, in any average of a group of 50 patterns the prices of many jobs will be too low and many will be too high. A competitor, if he has an adequate cost system furnishing accurate job costs, will be able to take without much trouble the more profitable jobs by quoting the lower correct price thereon, leaving the first foundry with the high-cost, low-selling-price jobs.

Weighted Average Costs

The foundryman should not allow a purchasing agent to talk him into quoting a flat price per pound for all his casting requirements unless he, the foundryman, first determines a weighted average of actual costs by patterns and specifies that the quotation is a lump-sum quotation for all the items in the quantities stated for each item, and that the price is subject to change if there is any deviation therefrom as to quantities, specifications, etc. Otherwise, he will live to regret it.

In the past, some trade disturbance has been caused in the industry by the foundry which produced, say, four different classes of work, two of which were sold at a profit and two at a loss, but which classes were sold at a profit and which at a loss were unknown to it. This disregard of costs did much to undermine the foundry's success; and, of course, the company did not play fairly with its competitors who were better located and equipped to manufacture the lines which unknowingly were sold at a loss.

It is not fair competition to be required to meet a price made upon guesswork, a price that may even be less than the actual cost of production, exclusive of selling and administrative expenses.

During the past several years the attitude of many foundries on the matter of determining costs of castings by patterns has been disappointing. It is common knowledge that in many companies little attention has been paid to costs and but little energy expended in establishing satisfactory cost departments to obtain accurate information.

Unfortunately, there is a feeling among many of the members of the casting industry that cost estimating and cost finding are things that can be dispensed with by substituting guesswork.

Most foundries are furnished a profit or loss statement on a scoop-shovel basis each month about 10 to 20 days after the end of the month. Few are furnished a budget forecasting the estimated profit or loss for the coming month before the month starts. How many companies actually prepare a budget each month forecasting their anticipated production, shipments, income and expense and profit and loss, and then compare the subsequent actual results of operation with that budget and account for the variances? This can be done and is being done by the author's company with splendid results.

Predetermined Costs

Each day, the casting industry is becoming more and more complex. Therefore, the need of accurate predetermined cost and other data on the conduct of business is becoming more and more important. Those companies in the industry operating without a proper knowledge of predetermined costs are in an unfavorable competitive position.

There is no substitute for continuous and efficient low-cost, high-quality production to assure a lasting prosperity in the casting industry. It improves quality, lowers selling prices, raises wages, creates jobs and enables a normal level of profits to be maintained. All substitutes lead to poor-quality castings, higher prices, contribute to inflation and unemployment and result finally in a depressed industry. Hence the need for cost control as an aid in getting satisfactory results.

Every member of the casting industry is interested in pricing his castings to show a fair profit. How can this profit be assured if the cost of castings by patterns is not first predetermined accurately by cost estimates before price schedules are prepared and quotations made?

Accurate job-cost data creates confidence in the minds of salesmanagers and salesmen that their company's prices are right and permit no deviation except for proven cause. It stiffens the determination of sales personnel to sell profits instead of tonnage.

It is the author's belief that the latest developments in the second round of increased wages and other costs is the start of the race for survival in many industries, including the casting industry. The race will be for greater efficiency and lower costs.

By these remarks it is not meant to imply that a serious over-all decline in business is here or coming

FORM 780

THE OHIO STEEL FOUNDRY COMPANY

Estimated__________ Actual__________

Copy for__________

COST ESTIMATE OF ROUGH CASTING

Made in__________Foundry

Customer and
Pattern No.__________

Description__________

Casting Rough Weight______lbs.
Weight of Heads & Gates______lbs.
Shop Defectives______% of Good Production
Furnace Loss______% of Charge
Fixed Recoverable Scrap______% of Charge

Compiled by______Approved by______
Cost Factor Period______
Date______Metal Mix______
Cope Flask Size x x Type Molding______
Drag Flask Size x x Kind of Pattern______
No. of Heat Treatments______ Condition of
No. of Castings per Mold______Pattern______
No. of Cores per Casting______
Yield______% of Charge to Total Production before Defectives
Yield______% of Good Metal Poured into Flasks to Total Production before Defectives
No. Pcs. Ordered______ per month
No. Pcs. Cast______No. Pcs. Scrap______
No. Scrapped Molds______No. Scrapped Cores______

Cost Per 100 Pounds

	Budget		Performance		
	Cost	% to Total Shop Cost	Cost	% to Total Shop Cost	Variance
1. Melted Metal, exclusive of Alloys:					
(a) Metal	$	%	$	%	$
(b) Conversion					
(c) Total	$	%	$	%	$
2. Direct Labor:					
(a) Mold ($ per casting)	$	%	$	%	$
(b) Core ($ per casting)					
(c) Clean ($ per casting)					
Total Direct Labor Cost	$	%	$	%	$
3. Anneal ($____N.T. per heat treatment)	$	%	$	%	$
4. Total of Items 1, 2 and 3	$	%	$	%	$
5. Add: Departmental and Shop Overhead					
(a) Mold Sand ($____ per N.T. Total Production	$	%	$	%	$
(b) Pour & Shakeout ($____ per N.T. Poured)					
(c) Other Mold (____% of Mold Direct Labor)					
(d) Core (____% of Core Direct Labor)					
(e) Clean (See Schedule)					
(f) Total Departmental Overhead	$		$		$
(g) General Shop Overhead (____% of $____ Mfg. Cost, exclusive of General Shop Overhead and Alloys)					
(h) Total Mold, Core & Clean Departmental Overhead plus General Shop Overhead	$	%	$	%	$
6. Alloys	$	%	$	%	$
7. Total Shop Cost, before defectives	$	%	$	%	$
8. Shop Defectives (____%) ($____ less $____)	$	%	$	%	$
9. Total Shop Cost after defectives	$	100.0%	$	100.0%	$
10. Adm. & Sales Expense (%) of Item 9	$		$		$
11. Commissions and Royalties	$		$		$
12. Total Cost, exclusive of Freight and Returns and Allowances	$		$		$
13. Margin of Profit (____% of above cost)	$		$		$
14. Provisions for Returns, Allowances & Frt.	$		$		$
15. Special Cost, Patterns, etc.	$		$		$
16. Estimated Selling Price per 100 lbs.	$		$		$
17. Present Selling Price per 100 lbs.	$		$		$

Remarks: Above costs do not include machining unless so stated.

MOLDING COST

Pattern No.________ Cope Flask Size Required x x Cope Flask Used x x
Production Center________ Drag Flask Size Required x x Drag Flask Used x x
Number Castings per Mold

Direct Labor Operation — Mold	PER CASTING				PER 100 POUNDS			
	Minutes		Cost		Minutes		Cost	
Item	P.W.	Actual	Budget	Actual	P.W.	Actual	Budget	Actual
1________Mold			$	$			$	$
2________Finish								
3 Coresetting								
4 Special Finish								
5 Closing								
6 Breaking								
7 Contingencies								
8 Total Mold Direct Labor								
9 Sand Cost								
Material $______per N.T. Total Prod.								
Overhead $______per N.T. Total Prod.								
10 Pour & Shakeout $______ per N.T. Poured								
11 Other Overhead______% of Mold Dir. Labor								
12 TOTAL MOLDING COST (% of Shop Cost)			$	$			$	$

CORE COST

Production Center________	Remarks							
______Cores from______Boxes	PER CASTING				PER 100 POUNDS			
Direct Labor Operation — Core	Minutes		Cost		Minutes		Cost	
Item	P.W.	Actual	Budget	Actual	P.W.	Actual	Budget	Actual
1________Coremaking			$	$			$	$
2________Finishing								
3________Coremaking								
4________Finishing								
5________Coremaking								
6________Finishing								
7 Breakage and Contingencies								
8 Total Core Direct Labor								
9 Core Overhead______% of Core Dir. Labor								
10 Core Overhead______% of Core Dir. Labor								
11 TOTAL CORE COST (% of Shop Cost)			$	$			$	$

CLEANING COST

	DIRECT LABOR						Overhead Rate % Direct Labor	Clean Overhead Per 100 Pounds	Total Clean Cost Per 100 Pounds	
Item Operation	Minutes Cstg.		Minutes 100#		D.L. Cost					
	P.W.	Actual	P.W.	Actual	Per Cstg.	Per 100#			Budget	Actual
1 Burning					$	$	%	$	$	$
2 Flogging Head										
3 Saw/Turn Head										
4 Sprue Cut										
5 Rough Chip										
6 Chip Defects										
7 Dress Welds										
8 Fin. Chip										
9 Grind ( )										
10 Weld										
11 Press										
12 Testing										
13 Rework										
14 Pickling										
15 Blast										
16 Other										
17 TOTAL CLEANCOST (% Shop Cost)					$	$	%	$	$	$

soon. The author does wish to convey the thought that there is additional risk in doing business today, and that there is a greater premium on finding methods of holding unit labor and material costs down, and of getting lower prices through lower costs and of finding out how to do it first.

Competition today makes it necessary to make a complete cost analysis by checking all phases of operations and reviewing again and again all cost saving possibilities, even though previously discarded as unnecessary or not worth the trouble. They may be worth the trouble now. Do not overlook the fact that in most cases one indirect laborer costs the foundry over $2500.00 a year. Does the foundry get value received?

Equipment Efficiency

Investigate the adequacy and efficiency of machines and equipment in each production center. Are they performing at a low competitive unit cost? Do they have excessive maintenance and downtime with accompanying high cost and loss of good production, and loss of gross and net income?

Accurately kept costs are an index of operating efficiency if maintained properly by production centers, because the relative efficiency of the various production centers of a plant can then be watched and compared periodically against not only past performance but also against predetermined standards.

What does a production center constitute? A production center constitutes the total area occupied by like machines or like foundry equipment plus the space necessary for material and tools and for the operators to work with freedom. For instance, a row of stand grinders in the cleaning room, squeezer machines in the molding department, etc. A molding department, for example, may be broken down into five production cost centers; (1) squeezer molding, (2) pin-lift molding, (3) floor molding, (4) pouring and shakeout, and (5) sand mill.

Accurately prepared costs by production centers brings to light, localizes and directs attention to inefficiencies in (a) management, (b) use of labor, (c) use of material, (d) existing methods, and (e) present equipment as well as spot-lighting many other inefficiencies needing attention; and, exercises the important function of lowering costs and holding them at the lowest possible level.

The size of most foundries today renders complete personal supervision of one executive practically impossible; therefore, the only reliable way by which executives can judge the efficiency in their organization is through a system of dependable cost and statistical reports, some of which should be submitted daily. To assure a profit, foundries must be operated and cost controlled on a day-to-day basis.

Keeping Casting Costs in Line

Once the prices of castings become too high, the industry may expect to lose a portion of its business to the competition from (a) forgings, (b) fabricated products and (c) other casting substitutes. The casting industry cannot hope to survive as an industry if it allows its prices to get out of line. To prevent its pricing from getting out of line, it must keep accurate costs by patterns, maintain adequate cost control, and produce quality castings at as low a cost as possible through the use of efficient methods, efficient machines, efficient supervision, etc. Waste must be eliminated.

In a drive to lower costs, the following points, among other things, should not be overlooked:

1. Install sound incentive wage systems.
2. Eliminate inefficient employees.
3. Eliminate poor material and inefficient equipment and methods.
4. Obtain co-operation in cutting down absenteeism.
5. Increase output through greater enthusiasm on the part of the workers.

In a previous talk the author stated that there were many objections advanced by members of the casting industry against installing adequate cost systems to enable compilation of accurate cost estimates by patterns. One of the objections advanced is that their particular foundry is different from all others, that no system which can be operated in a practical manner would give them true costs. This is a poor excuse. True, some lines of casting production lend themselves more readily to the determination of costs than others, but it is also true that no line is so complicated but that a system can be devised and operated in a fairly simple and practical manner which will give reasonably accurate results.

Another objection advanced has been the expense of operation. Many foundrymen feel that a cost system means endless details, red tape and the employment of a huge number of additional clerks. Yes, some additional clerical labor usually is required, but not to the extent that most foundrymen believe. The results obtained more than pay for themselves. It has been the author's personal observation that in most foundry offices that are not properly organized, sufficient unnecessary work is performed which, if eliminated, would cut to a minimum any extra labor of operating a good cost system.

Proper Use of Cost System

A production center cost system which furnishes data to compute costs by individual pattern numbers will not run itself; neither will it in itself reduce costs nor increase efficiency. This is strictly up to the foremen and top management.

A good cost system will give valuable information, but if this information is not properly used, the cost system is a waste of money. On the other hand, if the information is properly used, the cost system becomes a valuable asset.

It should be stated at this point that a cost system should be made to fit the operating conditions of the foundry and not the foundry to fit the cost system. A cost accounting system, if it is to work smoothly and satisfactorily, must be simple and practicable and coordinate with plant practices, and must have the full backing of the entire management of the company, especially the plant superintendent and the foremen.

Sound trade conditions throughout the casting industry demand that each foundry know its true costs, that it know its profitable and unprofitable jobs and that it obtain a reasonable and fairly equal profit on each class of work produced. Tailor-made jobs should be made

to stand on their own feet and pay their own way, and losses therefrom should not be absorbed by the profits of quantity production items.

The form of competition to which members of the casting industry do not object is the competition of a foundry which knows exactly what its castings cost by patterns; and whose prices, if low, are low because of advantages actually secured through volume or by reason of more efficient methods of production.

The competition which is most dreaded is that of the foundry which, having no proper knowledge of costs by patterns, sets prices which preclude the possibility of an adequate profit for any one.

The chief value of cost accounting lies in cost comparisons. Not only should the current month's actual operations be compared with those of previous months, but a comparison should be made of current operations with predetermined standards and predetermined monthly budgets. Variations should be investigated immediately.

Operating comparisons should be made, wherever practical, by production centers. Top management, in all fairness to its supervisors and workers, should inform the supervisors and the workers prior to the beginning of each month what it expects of their production centers. It should set a fair goal in the form of a budget, by production centers, both of production required from the production center and the amount of money that may be expended for labor, material and expense in obtaining the required production. Proper predetermined standards make for efficient production centers. It keeps the workers happy and the supervisors on their toes.

Budget Preparation

Progressive foundries today in order to lower their costs have capable men in complete charge of all methods, time studies and piece rate and allowance setting, with full authority and responsibility.

In setting up standards and monthly budgets and making any revisions thereto, it is essential to obtain joint participation between (a) top management, (b) cost department, and (c) the man who has to operate under the budget.

A good cost department plays an important part in the budget preparation and follow-up. However, the cost department should not act as nor be regarded as a detective. Its function should be to furnish adequate, concise, and understandable reports, to direct attention to those costs which are out of line. Top management through the president or other senior executive must shoulder the responsibility of finding out why the costs are high and out of line, and insist that corrective action be taken.

Production center cost accounting places responsibility where it belongs, namely, on the foreman of the production center. Too often, management talks in terms of departmental costs and hence gets no results from cost control because it should be talking in terms of the costs of the production centers making up the department. Some production centers in a department may be making money and others losing money.

A foundry whose molding department, for example, consists of five production cost centers, namely, squeezer machines, rollover machines, floor, pouring and shakeout, and sand mill, will have better cost control when it knows (a) what the cost of each production center is and (b) the tons produced therein each month, and (c) its rate of defective molds and defective castings.

Each molding production center of the molding department must know its current rate of shakeout molds, slagged molds and defective castings, and the relation thereof to total tonnage molded. It should know its cost of (a) direct labor for molding, (b) sand cost, (c) pouring and shakeout cost, and (d) production center general overhead. With such data available, plus necessary production statistics, high costs are localized and responsibility fixed.

Cleaning Cost Control

Production center cost accounting and cost control pays good dividends when applied to the cleaning department. To state that one's cleaning cost of castings is so much per ton is meaningless. The cleaning room, for effective cost control, should be broken down into production centers, each major cleaning operation being a production center. The direct labor cost of each cleaning production center should be determined, together with the overhead applicable thereto. It will surprise many when they become acquainted with variances in the overhead rates of the cleaning operations.

Each foundry will have its own ideas with respect to the number of production centers it may wish to set up for cost purposes. Some may want several production cost centers in a department, others, very few. The author feels that the number of production cost centers will vary with each company and is entirely dependent upon the degree of the accuracy required and refinement necessary in the determination of true cost of jobs.

A simple rule, too often neglected in cost control, is—"Arrange for joint participation in setting up standards and budgets between top management, the cost department and the man who will operate under them." Unless the supervisors share in the work of setting goals and standards and are satisfied that they are fair before they are started, they will not be sympathetic with the requirements and will tend to fight them instead of fighting to get them.

Conclusion

In conclusion, it may be stated that, in the writer's opinion, a sound cost accounting plan for any foundry is one which accomplishes the following:

1. Furnishes data for the preparation of financial statements.
2. Provides sufficient data to establish accurate (a) material costs, (b) direct labor costs, and (c) overhead costs by production centers and patterns.
3. Provides an adequate basis for estimating (predetermining) costs of castings by patterns for purpose of sales quotations instead of solely for post-mortem use.
4. Furnishes a means of control of profits by providing periodic comparisons of cost estimates and actual costs by pattern numbers.
5. Furnishes adequate data for the preparation of monthly variable budgets which project and control costs at various levels of operation.

PRECISION CASTING SMALL ALUMINUM IMPELLERS

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Development of methods for precision casting of small uncored impellers from aluminum alloys and the production of limited numbers of sample parts presented problems requiring a plaster mold, with adaptations of semi-centrifugal and static casting techniques.

Two types of impellers were produced. In both cases static casting would not permit the filling of the leading and trailing edges of the peripheral blades, and centrifugal force in a rotating mold offered the most practicable method of increasing molten metal pressure in the mold cavity. At the same time, assurance of a sound center required static solidification with a suitable riser. This was accomplished, upon complete filling of the mold, by stopping rotation of the mold after a lapse of time sufficient to permit freezing of the thin blades. This permitted the remainder of the casting to solidify under static conditions.

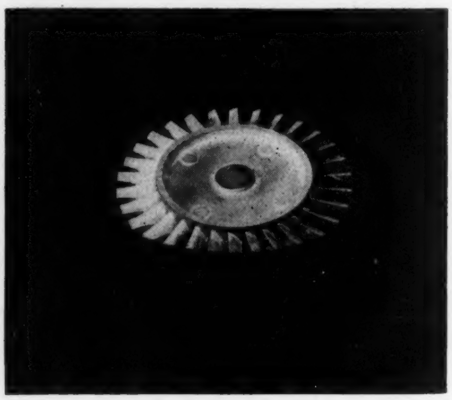


Fig. 1—Metal pattern in position on the parting board.

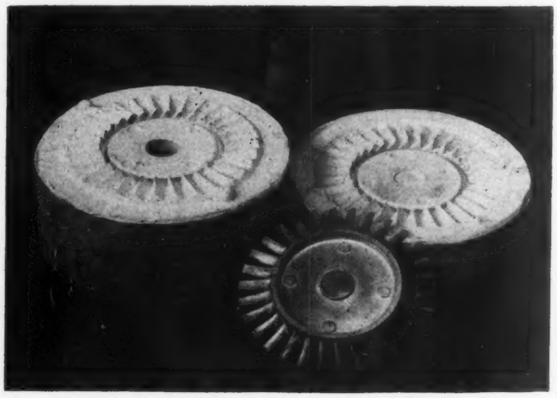


Fig. 2—Plaster mold after patterns have been drawn.

Permissible tolerances on dimensions and surface roughness made the use of a plaster mold desirable. A commercial product [1] was found to be satisfactory for this purpose because of its high crushing strength, smooth finish, and low shrinkage obtainable.

With blade thickness as low as 0.011 in., elimination of heat treatment was desirable because of the difficulty of properly supporting the thin sections and preventing distortion. A naturally-aging aluminum-base alloy with the nominal composition 5.25 per cent zinc and 0.50 per cent magnesium [1] provided the answer. Mechanical properties in excess of the specified minimum tensile strength of 32,000 psi, yield strength of 22,000 psi, and elongation of 3.0 per cent in 2 in. were obtained from plaster cast test bars after aging for a period of 21 days at room temperature.

Metal patterns were used in casting both impellers. One type permitted parting along edges of the blades and diagonally across the rim. A parting board with a plasticine mask was used in pouring the drag (Fig. 1). When the drag was removed from the board, the pattern remained imbedded in the plaster and held in position for pouring the cope. Runners and gates were cut into the cope section by hand, but can be made an integral part of the patterns.

The other impeller, as shown in Fig. 11, had overlapping blades of such shape that drawing a complete pattern would be impossible. Consequently, this part was fabricated by the use of cores placed radially in a cavity within the drag. In this case only a master core was machined and, in turn, its impression duplicated in a set of low-melting alloy [1] core boxes. The method chosen for supporting the cores in the mold cavity provided core prints as radial elements above the leading edge and below the trailing edge of the blade. When assembled in the mold cavity, support for the cores was

[1] Trade names of products used may be obtained from the author.

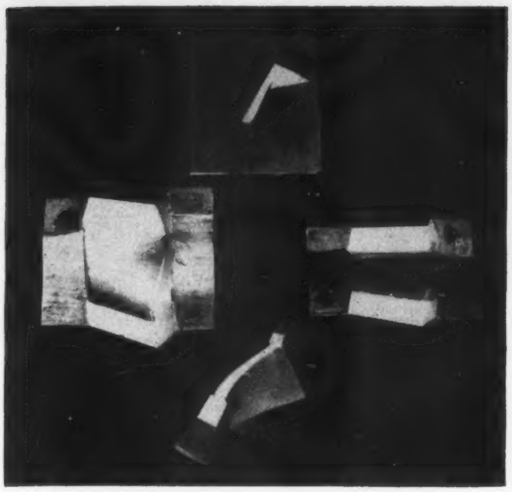


Fig. 3—Master pattern and core boxes used in producing molds for the impeller casting shown in Fig. 11.

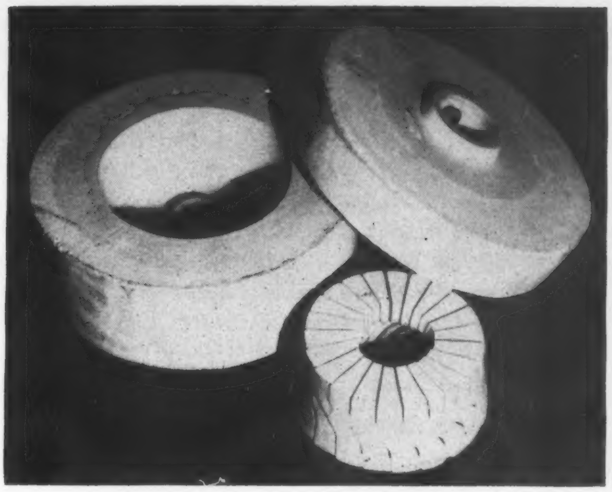


Fig. 4—Cope and drag halves of plaster mold and cores for producing impeller castings shown in Fig. 11.

obtained at the top, bottom, periphery, and hub of the section as well as radially from the hub of the casting to the tip of the blades (Figs. 4 and 5).

Plaster Practice

The plaster mold material was mixed in the proportions of 10 parts of plaster to 8 parts of water in accordance with usual practice as recommended by the manufacturer. In addition, it was found that a better surface was obtained upon the castings by assembling the molds before drying. Evaporation of water from the surfaces of the mold cavity left deposits which could not be brushed off and which resulted in pits on the casting. Drying assembled reduced evaporation from the inner surfaces so that no difficulty was encountered.

A parting compound consisting of two ounces of stearic acid and a small amount of a proprietary compound dissolved in a quart of gasoline allowed the mold to be easily separated and patterns withdrawn. The molds were dried in a conventional core oven for 18-20 hours at a temperature of 500 F, and were poured immediately upon removal.

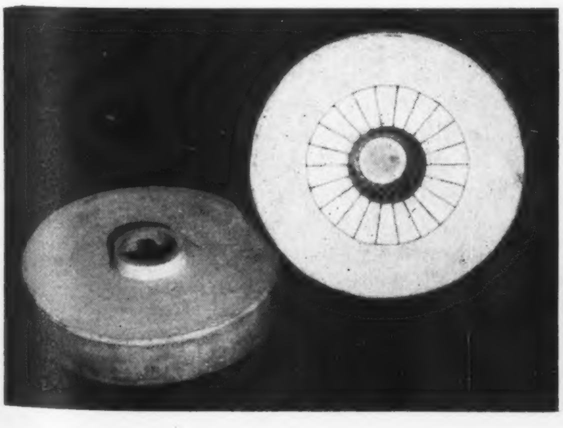
During the experimental stage all parts were subjected to x-ray and metallographic examination to obtain as complete an elimination of oxide inclusions and porosity as possible, and gating became the most troublesome feature of the casting process. Since provision for freezing the casting statically with an adequate riser was necessary, conventional methods of extremely rapid pour into the mold cavity were inadequate in filling the central riser with clean metal.

Gating and Risering

The final gating and runner arrangement was the result of efforts to overcome defects encountered and is illustrated in Figs. 6, 8 and 9. Gating into the rim of the larger impeller prevented oxide inclusions and folds caused by spattering and turbulence. Reservoirs beyond the runners leading down to the gates for centrifuging the metal and providing for metal flow against rotation also removed oxide inclusions and prevented entrapment of air. A flat steel deflector, described later, prevented interruption of the metal stream and subsequent cold shuts in the blades. It became apparent that in using this system of gates and runners the rate of pouring was not critical.

Two gates were cut into the rim of the impeller diametrically opposite each other. Metal entered these

Figs. 5, 6 and 7 (left to right)—Plaster mold with cores in place in the drag. Photograph of assembled plaster mold showing reservoirs and channels cut into the cope surface. Assembled plaster mold showing steel deflector for directing metal into reservoirs, and collar used to protect the asbestos board around the pouring cup.



gates from runners through the cope, which were inclined inward to provide quiet flow. The runners connected with reservoirs in the top surface of the cope lying slightly farther from the center of rotation than the runners to provide a body of centrifuged metal. This effectively reduced turbulence and removed heavy oxides and dross. To further aid in filling the riser, two additional channels were cut from the bottom of the reservoirs to the riser cavity through which hot metal could flow as rotation slowed and stopped.

In casting the impeller illustrated in Fig. 11, the inclined runners from the reservoirs led to gates cut into the riser cavity itself at a point slightly above the junction of the riser and impeller hub. No further gating change was necessary.

Molten metal was directed into the cope reservoirs by a 0.012 gauge steel deflector directly over the riser cavity (Fig. 7). This deflector was spray-coated with permanent mold dressing to prevent alloying and served two purposes: to direct the metal into the reservoirs, and to provide venting from the riser to the atmosphere through channels formed between the bent-up ears and the pouring cup. The molten metal in the reservoirs was confined during rotation by a sheet of $\frac{3}{16}$-in. asbestos board between the mold and the clamping plate.

Since all castings were required to meet rigid x-ray inspection, careful melting practice was observed. The aluminum alloy was melted in small steel crucibles in batches sufficient to pour a single mold. The steel crucibles were coated with a wash of chalk and sodium silicate to prevent alloying, and were heated in a gas-fired furnace in such a way that products of combustion did not directly contact the crucible contents.

After the charge was melted, the metal was fluxed with dry nitrogen introduced through a perforated graphite tube for 15 min. During the fluxing period the metal was brought to the pouring temperature of 1400 F, skimmed, and poured.

Molds for castings of the type shown in Fig. 10 were rotated at 600 rpm and those of Fig. 11 at 850 rpm. These correspond to peripheral speeds of 1140 fpm and 1224 fpm, respectively, on the castings.

The castings were readily removed from the plaster by soaking in water. Gates and risers were removed by bandsawing, and the flash at parting lines by hand filing before the final machining. Yields of castings as compared to metal poured were 31 to 37 per cent.

Variation in thickness of the blades of the larger impeller (Fig. 10) amounted to a maximum of 0.003 in., measured across the parting line. In the smaller impeller, an accuracy in blade thickness of plus or minus 0.010 in. was obtained in placing the 22 cores.

Satisfactory sample castings were produced from ASTM-4 magnesium alloy by using identical molds and gating. Sulphur dioxide was used as the protective atmosphere by flushing the molds before and during pouring with that gas.

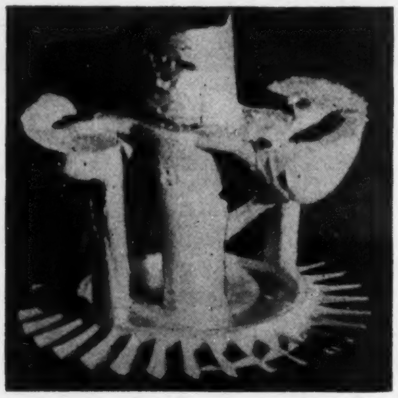


Fig. 8—Casting showing gating and runner arrangement

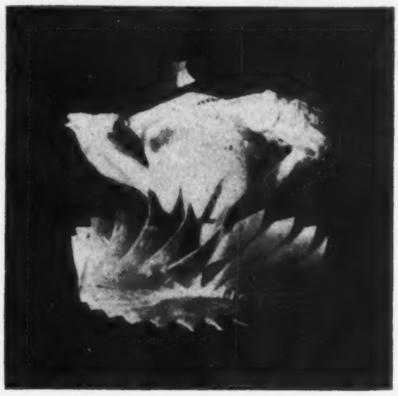


Fig. 9—Rough impeller casting as removed from mold.

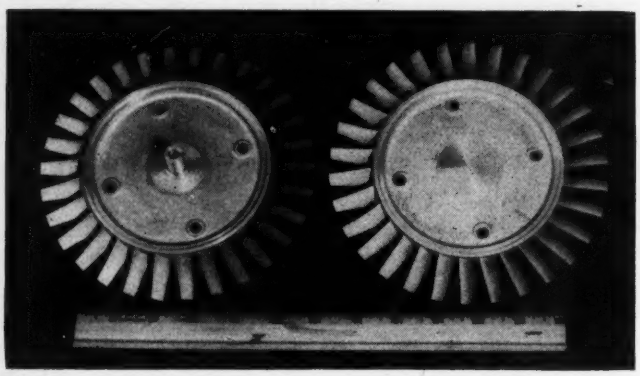


Fig. 10—Photograph of finished plaster-cast impellers.

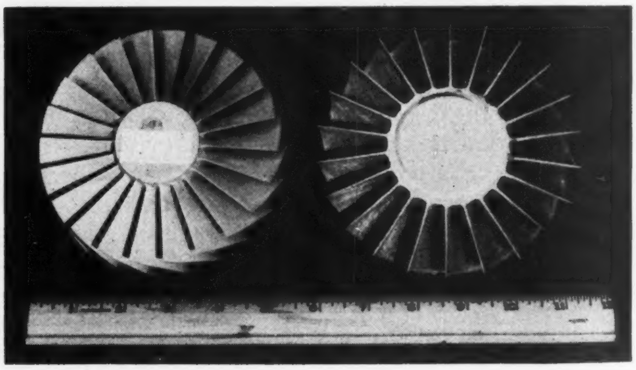


Fig. 11—Smaller plaster-cast impellers after cleanup.

LECTURE COMMITTEE NAMES NELSON AS 1948 SPEAKER

AT A CURRENT meeting of the Annual Lecture Committee it was unanimously agreed that Charles E. Nelson, assistant director of metallurgical research, The Dow Chemical Co., Midland, Mich., would deliver the 1948 Charles Edgar Hoyt Annual Lecture. The tentative title of Mr. Nelson's treatise will be "The Control of Grain Size in Magnesium Castings."

C. E. Nelson

The selection of Mr. Nelson continues the tradition of securing a foremost foundry technologist to discuss an outstanding technical problem.

At the same time the Association's Annual Lecture Committee announced that a series of five lectures on foundry control. would be presented at the 52nd Annual Meeting. The course is being planned to cover (1) steel, (2) cast iron, (3) malleable, (4) light alloys and (5) brass, bronze and nickel alloys.

Lecture Speakers

Speakers for these sessions are as follows: *Malleable,* Myron O'Booth, plant manager, Central Foundry Div., General Motors Corp., Saginaw, Mich., *Steel,* John Juppenlatz, chief metallurgist, Lebanon Steel Foundry, Lebanon, Pa.; *Cast Iron,* Fred J. Walls, metallurgist, International Nickel Co., Detroit; *Light Alloys,* E. V. Blackmun, chief works metallurgist, Aluminum Co. of America, Cleveland; and *Brass, Bronze and Nickel Alloys,* William Romanoff, technical superintendent, H. Kramer & Co., Chicago.

It is planned to consolidate and publish the papers which will be prepared for these sessions as a book on foundry control procedures.

Final Notice Of Dues Payment To Be Mailed

SEVERAL THOUSAND Association members have received dues invoices for memberships subject to renewal on July 1. It is essential that prompt payment be made to aid in supporting the activities of the Association. The A.F.A. by-laws state that a full 90 days will be allowed for renewals, after which period it will be necessary to remove from the membership rolls names of those members whose dues are three months in arrears.

Final Notice Mailed

As was published in the June, AMERICAN FOUNDRYMAN, the 90-day period for payment of dues will be strictly enforced. A "final notice" will be mailed from the National Office on August 31. Thirty days following the mailing of this "final notice," as required by the by-laws, those who fail to send in dues payments will be notified that they are no longer members of the society.

Can You Help?

A.F.A. is anxious to obtain some copies of A.F.A. TRANSACTIONS, Volume 52 (1944) from members who may have no use for copies in their files. The supply of this volume is entirely exhausted and a number of important requests have been received for this edition.

For intact copies in good condition A.F.A. will be glad to make arrangements for purchase. If you have a copy of Volume 52 which you do not need, please forward promptly to: The Secretary, American Foundrymen's Ass'n, 222 West Adams Street, Chicago 6, Ill.

For the purposes of local follow-up, the National Office will co-operate with chapter secretaries and membership committee chairmen in submitting names of "delinquent" members as soon as possible after August 1.

All A.F.A. members whose dues are payable on July 1 are urged to cooperate and give immediate attention to dues invoices, thus avoiding the necessity of being required to reapply for membership after the 90-day period of grace has expired. It should be pointed out also that Art. II, Sec. 6 of the National by-laws states: "The resignation of a member whose dues are in arrears shall not be accepted."

During the month of July many members took advantage of the 20% book discount that was made available to them for 30 days following their renewals.

Castings Session For Machine Tool Meeting

A MOST IMPORTANT technical event next month, September 17-26, is the staging of the 1947 Machine Tool Show in the Dodge-Chicago plant, Chicago. The various societies allied with the machine tool industry have been invited to organize evening sessions for the presentation of technical lectures. The American Foundrymen's Association is cooperating with the American Society of Tool Engineers in organizing a session on "When and How To Use Cast Iron." This will be held at the Hotel Sherman, the evening of Friday, September 19, with two speakers on the program. T. E. Eagan, chief metallurgist, Cooper-Bessemer Corp., Grove City, Pa., will direct his talk to the design engineer stressing the attributes of gray iron, its physical characteristics, wear resistance and machinability.

M. S. Curtis, assistant director of engineering, The Warner & Swasey Co., Cleveland, will be the second speaker representing the ASTE.

Other societies aiding in staging sessions for the show which is being sponsored by the National Machine Tool Builders Association are the American Society of Mechanical Engineers and Society of Automotive Engineers.

SAFETY AND HYGIENE IN THE FOUNDRY

E. Eugene Ballard
Chief Engineer
Lester B. Knight & Associates, Inc.
Chicago

THE FOUNDRY IS A GOOD PLACE TO WORK—and it can be made a better place to work by continuing efforts in furthering safety, employe welfare and hygiene.

In perhaps no other industry has there been greater improvement in working conditions in the past decade. Management has become cognizant of the major obligation of providing safe and healthful environment for employes, and the provision of such conditions has made foundries healthful and attractive.

While great improvement has been accomplished, there yet remains an opportunity and even obligation in many plants for providing safe and healthful working conditions to make the foundry a better place to work. Perhaps the most important initial step in any plant for such a program is the maintenance of good housekeeping, because a clean, neat plant usually is a safe plant. Good housekeeping may be established in any plant without undue expense, and such expense will be reflected in reduced operating costs. Having "a place for everything and everything in its place" is one of the best time savers one can have, and pays dividends in servicing the various departmental operations. Here are suggestions for a good housekeeping program:

Establish and maintain adequate trucking aisles and do not permit them to become obstructed. If floor conditions permit, painted aisle lines will provide an aid.

Establish and maintain space for idle flasks, molding and other equipment, arranged so items may be located quickly when needed for production.

Keep floors clean; sprinkle before sweeping to allay dust conditions.

Provide racks for loose tools, tongs, bails, bars, etc., and keep unused equipment in a specified place.

Require employes to keep their own "corner" or working area neat and clean with tools in proper place.

Keep ledges and window sills free of debris. Beveled sills prevent use of these areas as catch-alls.

Clean out the seldom used corners both inside and outside the plant and keep them so.

Make foremen responsible for housekeeping in their respective departments, and make regular and occasional unannounced inspection tours to further interest in and maintenance of program.

After a thorough clean-up campaign, interior painting is advised. Nothing adds more to the brightness of a plant and employe morale than a new "paint job."

Adequate lighting, both general and local, is essential both to housekeeping and efficient production.

Views of foundry flask storage yard before clean-up.

Views of foundry flask storage yard after clean-up.

Of utmost importance is cleanliness of locker and wash rooms. Adequate janitor service as well as personal rules for employes are essential in maintaining such facilities to satisfactory standards.

Good housekeeping is the first requisite for safety. There are, of course, some hazardous jobs in foundry operations, as there are in various other industries, but all such jobs can be protected and employes trained in safety measures so that hazards may be reduced to a minimum.

Here are some suggestions toward making your plant a safe one:

Proper design and arrangement of equipment to provide safe operation.

Adequate instruction and training of the employe for safety in his particular job.

Enforced use, as a condition of employment, of proper safety equipment such as safety glasses, goggles, respirators, gloves, aprons, leggings, and safety shoes.

Educational program for all employes in safety.

Maintenance of a safety committee with rotating representation from each department. Encourage their work and take action on their recommendations.

Campaign for accident prevention rather than corrective measures after some one has been injured.

Regular thorough inspections, particularly of material handling equipment, such as trucks, cranes, hoists, monorails, chains, cables, etc.

Establish program for proper maintenance of such equipment. Keep on hand replacement parts so that repairs may be made promptly. When signs of undue wear or damage to equipment is noted, fix it now rather than wait until the break occurs. Preventive maintenance is good insurance against hazardous conditions and costly shut-downs. Do not overload material handling equipment. Top-heavy loads should be prohibited and proper boxes or containers provided for transporting materials and castings.

Study accident reports, investigate causes and take preventive measures against repetition.

Recent years have focused great attention on the importance of industrial hygiene, some companies having taken the lead in this field in maintaining their own staffs of medical and industrial hygiene personnel with outstanding results. Typical programs begin with the pre-employment examination and carry through with periodic physical examinations of employes, regular surveys for unhealthful working conditions, and maintenance of first aid and emergency hospital facilities with graduate nurse in charge where the number of employes justifies. Cooperation of operating and engineering personnel with the medical department is essential to the success of the program.

Hygiene in Smaller Plants

Such programs have greatly improved plant working conditions and employe health and are well worth while in the larger plants and groups of plants. The smaller operator can initiate similar programs on a scale to suit his needs by enlisting the cooperation of the company doctor, local or state health authorities or professional industrial hygienists.

We cannot all have the "wide open spaces that we love" but we can make greater strides in making our foundries clean, healthful and inviting. One of the largest problems, other than production "headaches," in any foundry is proper ventilation, which is paramount in maintaining good working conditions. This is a broad subject on which volumes could be written, but to touch it briefly, foundry ventilation might be divided into three separate classifications.

1. General area ventilation.
2. Exhaust of fume or smoke at source.
3. Exhaust for dust suppression.

Each plant is a separate problem deserving individual study, and careful engineering consideration should be devoted to develop the ideal solutions. It generally is most desirable to trap fume or dust at the source,

rather than by general ventilation, although there are many areas which, due to physical conditions, can be cleared only by general ventilation. Frequently a combination of general ventilation and localized exhausts is desirable; however, the latter should be favored wherever possible since such arrangements cause less load on the plant heating system.

All too often exhaust fans are installed without regard for the heating loss and resultant load on the plant heating system, and without considering that the fume and smoke-laden air removed from a room must be replaced by "make-up" air, either by infiltration or openings from adjoining buildings or areas. A powered exhaust will not do a good job working against a partial vacuum, so that it is necessary to supply clean make-up air which should be brought in near the working level, preferably through heating units, to maintain comfortable atmosphere during cold weather. In the case of localized exhausts, it is often possible to supply make-up air near the point of exhaust inlets without throwing the heating arrangements out of balance.

This foundry industry of ours is one of the oldest, and we who have it "in our veins" think it one of the best. The foundry is a good place to work, and we must hold that thought before us at all times and continue our efforts to make it a better place to work.

Acknowledgment

The author wishes to acknowledge the courtesy of E. A. Williams, vice-president, National Bearing Division, American Brake Shoe Co., St. Louis, in furnishing the plant photographs used to illustrate the paper.

Magnesium Processing and Storage Standards for Fire Prevention Listed

Causes and control of magnesium fires are given in the April 1947 quarterly report of the National Fire Protection Association. Based on test and fire data, the recommendations for preventing and extinguishing magnesium fires indicate that care and proper equipment will eliminate fire hazards almost entirely. Adequate fire protection will keep fire damage to a minimum.

The ignition temperature of magnesium is generally considered to be very close to the melting point, 1204 F, but the report points out that ribbon, chips and fine shavings can be ignited at temperatures of 950 F and below. In the case of certain alloys where the eutectic melts as low as 800 F, the metal may ignite if held sufficiently long at this lower temperature.

Silver Nitrate Test

Segregation for storage is important and a simple silver nitrate spot test may be made to identify magnesium and its alloys. The test is especially effective in distinguishing between aluminum and magnesium alloys.

The test consists of placing a drop of silver nitrate solution (5 g. $AgNO_3$ in a liter of distilled water) on the metal to be tested. A clean spot must be prepared first with sand paper or steel wool. An immediate black coloration (essentially reduced silver) indicates magnesium. No coloration appears on aluminum or most other metals. Zinc and cadmium show a coloration after approximately one hour.

Extinguishing agents for magnesium fires include G-1 powder and automatic sprinkler systems. Water streams may be used for combustible materials near magnesium fires. Extreme care must be taken to avoid accumulation of pools into which molten magnesium may run and cause severe explosions.

Causes of Fires

The most common causes of magnesium fires reported by the NFPA Committee on Magnesium are listed below:

Molten Magnesium. 1. Poor furnace design and maintenance. 2. Failure to inspect melting pots regularly.

Magnesium ingots. 1. Failure to store in small piles with adequate aisle space. 2. Storage near combustible materials.

Scrap storage. Failure to store turnings, etc. in tightly closed containers in small detached sheds. Storage in burlap bags caused a number of serious fires.

Magnesium castings. 1. Poor housekeeping, inadequate aisle clearance, proximity to combustibles and the accumulation of magnesium dust. 2. Woodworking and magnesium working operations carried on in the same room resulting in readily combustible mixtures of wood and magnesium powders.

Heat treating ovens. 1. Failure of furnace control equipment resulting in excessive temperatures—aggravated by failure of sulphur dioxide system. 2. Failure to clean chips and dust from castings prior to heat treatment.

Machining operations. Dull tools and water solution coolants.

Pictured below is Daniel Pakela and his "foundry family," they have contributed a total of 83 years service to the foundry industry. Mr. Pakela, his daughter and three sons are associated with the Erie Malleable Iron Co., Erie, Pa. Standing are Mary and Frank who have 6 and 9 year service records with Erie Malleable and seated (left to right) are Anthony, Mr. Pakela and Walter who tally 10, 40 and 18 years respectively. Mr. Pakela has been a molder for 35 years.

THE PROBLEM of obtaining globular, randomly dispersed sulphides in well-killed cast steels has been recognized for years. Low iron oxide contents which favor freedom from blowholes during solidification tend to promote thin, intergranular sulphides detrimental to ductility. High iron oxide contents, on the other hand, promote globular, randomly dispersed sulphides (a requirement for high ductility), but also increase the susceptibility to gassiness. Consequently, it is difficult to produce sound, ductile cast steel not deoxidized in any special manner, because its quality is partly dependent on the degree of oxidation at the time the steel is poured. This factor cannot readily be determined.

Sims[1] has proposed the use of large quantities of aluminum to combine freedom from porosity with high ductility, while Gagnebin[2] has suggested a combination of calcium silicide and aluminum for the same purpose. Both methods, however, require proper melting technique, including a vigorous boil to insure high quality steel. No deoxidation method yet proposed can consistently control the sulphide form in well-killed steel, regardless of the melting technique used to produce the steel.

In addition to refining the grain, selenium has the specific ability to coalesce the intergranular sulphides in low-oxide, well-killed cast steel, and thereby to improve its ductility. A demonstration of this phenomenon under a variety of conditions, as well as a theory for the mechanism of its occurrence, are discussed. A deoxidation practice for cast steel utilizing selenium is proposed and consists of the ladle addition of 0.08 per cent calcium and 0.05 per cent selenium. Extensive tests in laboratory and commercial heats show that calcium selenium promoted high ductility in steels ranging from 75,000 to 180,000 psi tensile strength and melted in acid electric, basic electric, and basic open-hearth furnaces. Calcium selenium promoted better ductility and was less likely to produce heats of low ductility than other methods of deoxidation. Moreover, it appeared to accommodate a broad latitude in melting conditions and therefore should assist in the consistent production of high quality cast steel.

SELENIUM ADDITIONS TO CAST STEEL

Influence on Sulphide Inclusions and Ductility

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Metallurgist
The International Nickel Co., Inc.
Bayonne, N. J.

This paper presents a new deoxidation procedure involving the use of selenium, which has been found to promote sulphide coalescence under a variety of conditions. A demonstration of this phenomenon, the mechanism of its occurrence, and tests of the proposed deoxidation procedure in both laboratory and commercial heats, are discussed.

Selenium Promotes Agglomeration

An effective demonstration of the influence of selenium on the ductility and sulphide form of a high sulphur, nickel-manganese steel, normalized and tempered is shown in Fig. 1. This heat was fractioned to show successively the influence of oxidation, aluminum deoxidation and selenium additions.

Aluminum destroyed the globular sulphides and ductility of the oxidized state, while 0.05 per cent selenium partially coalesced the sulphides, and 0.15 per cent selenium fully agglomerated them and restored the original ductility. The effect of progressive additions of selenium on the mechanical properties of aluminum-killed steel containing a normal amount of sulphur is shown in Fig. 2.

Mechanism of Sulphide Agglomeration

When selenium is added to steel, it appears to form manganese selenides which absorb the sulphides in the steel and then promote their rejection from solution before solidification is complete. The manganese or manganese-iron selenides are of medium gray color and appear to be miscible in all proportions with manganese sulphides, as no separation of the phases was noted. Figure 3 shows a typical manganese selenide-manganese sulphide inclusion in an aluminum-killed steel. The black angular constituent was absent in aluminum-free steel and therefore may be aluminum sulphide, since it varied directly with the amount of aluminum used for deoxidation.

Evidence bearing on the temperature at which sulphides were rejected from steel was developed by noting the sulphide location relative to the primary dendrite bodies and by heating steels to incipient melting to determine how much burning occurred before the sulphides disappeared. Both examinations were conducted on specimens suspended in an induction coil in a location to provide a thermal gradient, and then heated until one end melted, thus providing all degrees of overheating in a single specimen.

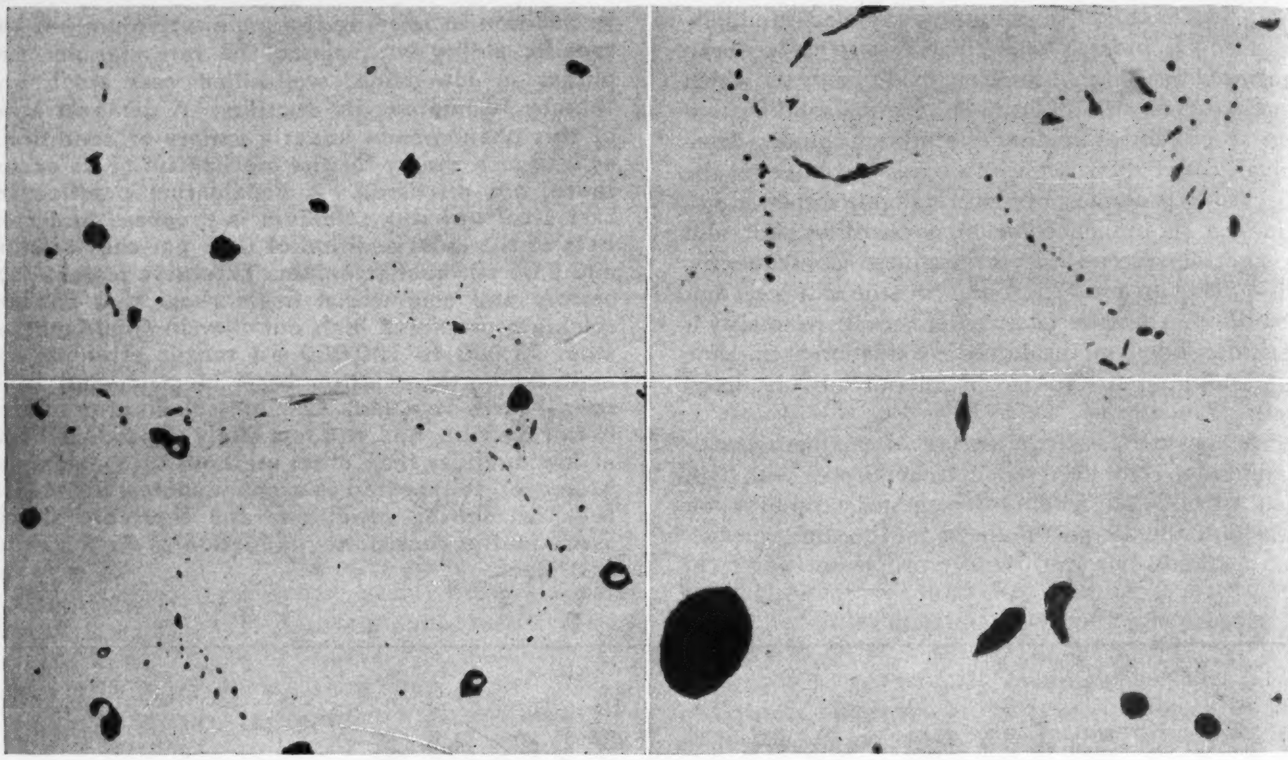

Fig. 1—The sulphide form and ductility in a Nickel-Manganese Cast Steel containing 0.07 per cent sulphur and fractioned to show the influence of various ladle additions. X500, unetched. Top, Left—Partly oxidized; reduction in area 45.0 per cent. Top, Right—0.06 per cent Aluminum added; reduction in area 16.0 per cent. Bottom, Left—0.06 per cent Aluminum and 0.05 Selenium added; reduction in area 15.0 per cent. Bottom, Right—0.06 per cent Aluminum and 0.15 Selenium added; reduction in area 47.0 per cent.

TABLE 1.—COMPARISON OF INFLUENCE OF SELENIUM ALONE VS. PARTIAL REPLACEMENT BY CALCIUM ON THE DUCTILITY OF CAST STEEL

Nominal Composition: C 0.3, Ni 1.5, Mn 1.5, Si 0.35, S 0.04
Heat Treatment: Normalized and Drawn.

Mark	Ladle Addition, Percent Al	Ca*	Se	Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong., percent	Red. in Area, percent
12261C	0.06	—	0.08	61	88	27.7	52.2
D	0.06	—	0.10	60	84	30.5	60.1
12487A	0.06	—	—	67	90	21.0	34.7
B	0.06	0.10	—	65	94	23.0	44.3
C	0.06	0.10	0.02	62	93	23.5	52.5
12437B	0.06	—	0.02	66	91	20.0	34.1
C	0.06	0.10	0.02	67	96	24.2	49.7
12289	0.06	0.10	0.02	64	89	28.0	58.3

*Added as CaSi.

Microspecimens from longitudinal sections of two steels, representing a brittle steel with intergranular sulphides and a ductile steel with coarse, manganese selenide sulphides, are shown in Figs. 4 and 5. These specimens were etched with a copper chloride etchant* similar to Stead's reagent in order to reveal the dendritic pattern of solidification.

*Dendritic etch developed by R. A. Flinn, 20 gr. $CuCl_2$, 50 cc. 12N HCl, 100 cc. C_2H_5OH, 250 cc. H_2O

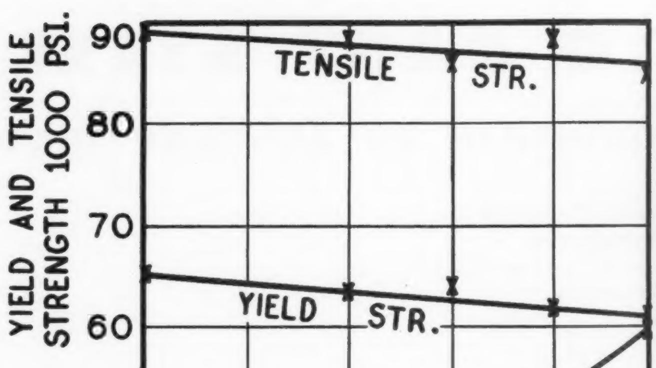

Fig. 2—The influence of Selenium on the mechanical properties of Aluminum-Killed Nickel-Manganese Cast Steel.

Fig. 3—Complex Sulphide containing Selenium in Cast Steel finished with 0.12 per cent Aluminum, 0.10 per cent Selenium. X1000.

In the steel of low ductility, the sulphides were located centrally in the inter-dendritic filling, and it was in this zone that melting was initiated. The dendritic pattern of the selenium steel was not as sharply defined as that of the brittle steel, and the sulphides usually were found at the edge of the inter-dendritic filling adjoining a dendrite body. Melting in this steel also was initiated at the center zone of the inter-dendritic filling, so that considerable melting occurred

TABLE 2.—DUCTILITY OF CAST STEEL WITH TITANIUM AND ZIRCONIUM PARTIALLY REPLACING SELENIUM

Nominal Composition: C 0.3, Ni 1.5, Mn 1.5, Si 0.35, S 0.04

Heat Treatment: Normalized and Drawn.

Mark	Ladle Addition, Percent Al	Se	Other	Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong. percent	Red. in Area, percent
12661	0.08	0.10	0.10 Zr	69	91	22.5	37.2
12560	0	0.03	0.10 Zr	65	87	22.5	34.4
12605A	0.08	—	0.10 Ti	57	100	19.5	40.3
B	0.08	0.02	0.10 Ti	53	109	19.5	29.9
12561	0	0.03	0.05 Ti	68	87	23.0	38.2
12562	0	0.03	0.10 Ti	72	96	20.5	33.5

without affecting the sulphides containing selenium.

Thus it appears that intergranular sulphides are rejected from the last remaining liquid during the solidification of steel and consequently weaken these already highly segregated zones. Selenium appears to associate with the sulphides and to promote their rejection from solution at a relatively early stage in solidification. Therefore, there is time for coalescence in the remaining liquid and opportunity for deposition in locations less damaging than the center of the highly segregated zones.

It appeared from the tests that it was necessary to

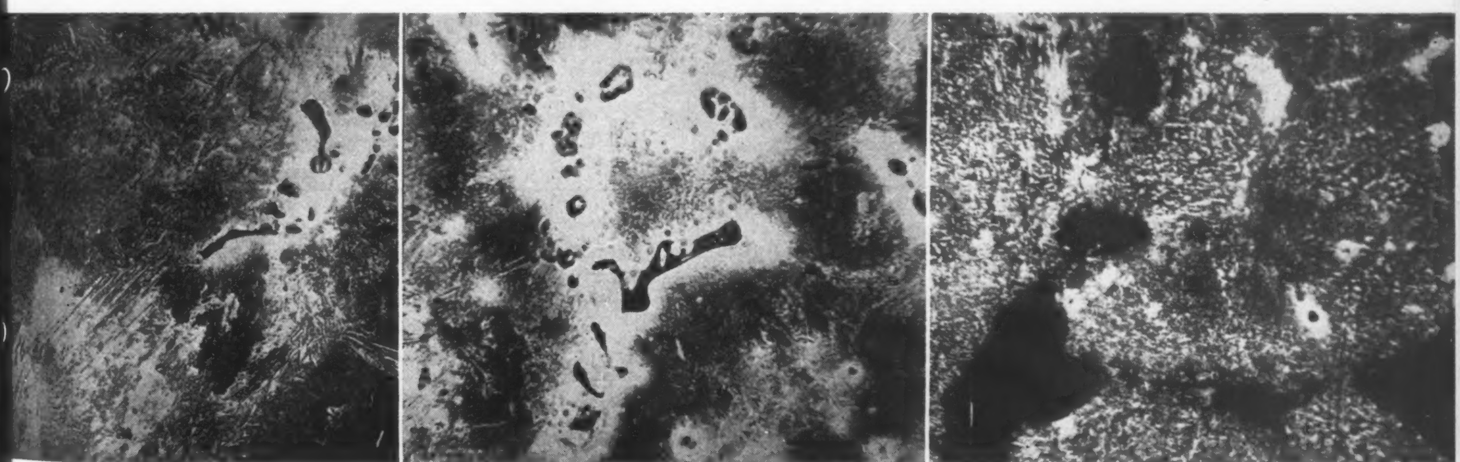

Fig. 4—Initiation and progression of burning in a Nickel-Manganese Cast Steel of low ductility containing intergranular Sulphides. X250. Dendritic etch.

Fig. 5—Initiation and progression of burning in a Nickel-Manganese, Selenium-Containing Cast Steel of high ductility. X250. Dendritic etch.

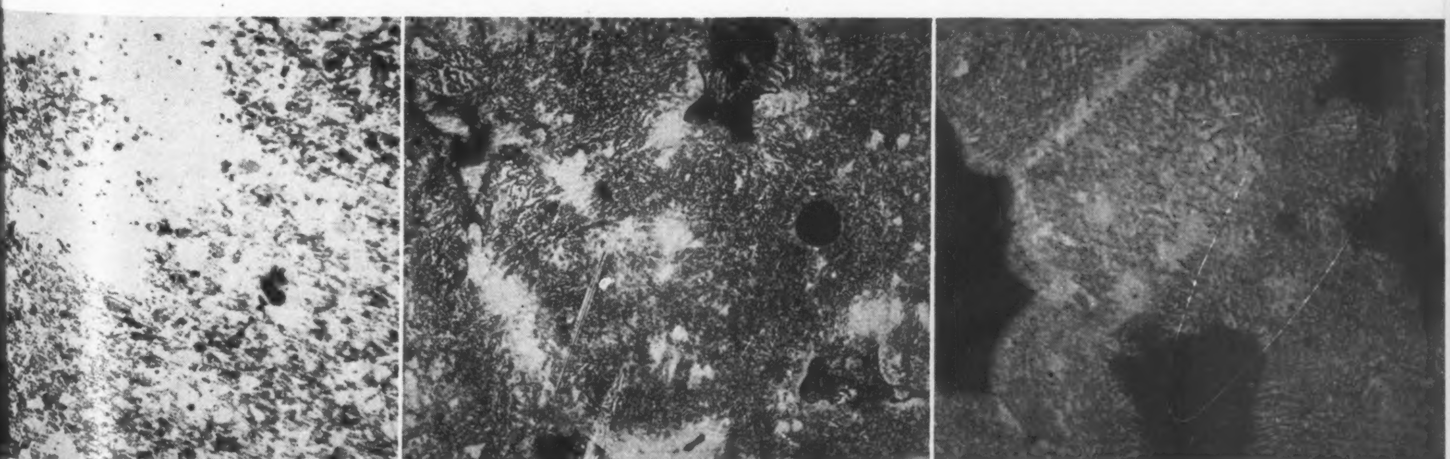

TABLE 3.—INFLUENCE OF CALCIUM SELENIUM ON DUCTILITY OF A VARIETY OF INDUCTION MELTED CAST STEEL COMPOSITIONS FINISHED WITH 0.02 PER CENT ALUMINUM

Type	Composition, percent C	Ni	Mn	Si	Mo	Cr	V	Ti	Heat Treatment, of (1 hr. each Air Cool)	Ladle Additions, percent Al	Ca	Se	Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong., per cent	Red. in Area, per cent	Charpy Vee Notch, ft. lb.
Carbon	0.3		0.75	0.35					1650-1200	0.02			49	72	21.5	29.2	21
	0.3		0.75	0.35						0.02	0.05	0.03	49	73	30.0	50.0	42
Nickel Manganese	0.3	1.5	1.5	0.35					1600-1200	0.02			66	93	18.5	28.5	19
	0.3	1.5	1.5	0.35						0.02	0.05	0.03	67	93	27.5	50.0	38
Nickel Molybdenum	0.3	1.7	0.75	0.35	0.25				1600-1200	0.02			68	88	18.5	26.8	21
	0.3	1.7	0.75	0.35	0.25					0.02	0.05	0.03	62	87	26.5	52.5	39
Nickel Chromium	0.35	1.5	0.75	0.35		0.75			1600-1200	0.02			73	103	13.5	21.7	16
	0.35	1.5	0.75	0.35		0.75				0.02	0.05	0.03	71	100	23.0	48.5	36
Nickel Vanadium	0.3	1.5	0.75	0.35			0.10		1600-1200	0.02			73	88	17.5	24.1	16
	0.3	1.5	0.75	0.35			0.10			0.02	0.05	0.03	70	86	29.5	53.9	48
Nickel Silicon	0.22	1.5	0.9	1.2					1675-1000	0.02			67	88	25.0	36.4	
	0.22	1.5	0.9	1.2						0.02	0.05	0.03	64	88	28.0	51.4	
Manganese Titanium	0.3		1.6	0.35				0.1	1600-1200				67	94	19.0	32.5	
	0.3		1.6	0.35				0.1			0.05	0.03	66	93	22.0	36.9	

NOTE: S and P ranged from 0.03-0.04 percent.

TABLE 4.—THE INFLUENCE OF CALCIUM SELENIUM DEOXIDATION ON THE DUCTILITY OF NICKEL MANGANESE DIRECT ARC FURNACE CAST STEEL

Heat Treatment—Normalized and Drawn

Mark	Composition, percent C	Ni	Mn	Si	S	P	Ladle Additions, percent Al	Ca	Se	Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong., percent	Red. in Area, percent
13212B	0.22	1.39	1.40	0.23	0.035	0.06	0.04			70	87	25.0	39.4
13212A							0.02	0.07	0.04	72	90	27.2	51.4
13223-1	0.24	1.24	1.01	0.38	0.044	0.035	0.025			65	86	22.5	30.2
13223-10							0.02		0.10	61	82	29.0	50.6
13223-14								0.08	0.04	61	84	30.5	58.1
13202-A	0.30	1.27	1.35	0.25			0.025			66	91	22.0	36.0
13202-B							0.025	0.05	0.03	69	94	25.5	51.4

TABLE 5.—INFLUENCE OF LADLE ADDITIONS ON MECHANICAL PROPERTIES OF CAST STEELS IN HEAVY SECTIONS*

Type	Composition, percent C	Ni	Mn	Si	P	S	V	Ladle Additions, percent	Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong., percent	Red. in Area, percent	Charpy Vee Notch, ft. lb.
Nickel Manganese	0.33	1.53	1.52	0.41	0.03†	0.03†		None	56	90	12.5	17.4	14
	0.29	1.52	1.45	0.33	0.033	0.026		Heavily Oxidized	56	84	24.5	37.9	34
	0.30	1.52	1.48	0.32	0.035†	0.025†		0.1Se	59	86	23.7	40.0	
	0.3†	1.5†	1.5†	0.35†	0.03†	0.025†		0.2Se	58	87	21.0	32.5	
	0.3†	1.5†	1.5†	0.35†	0.03†	0.025†		0.1Ca, 0.1Se	57	86	25.0	43.7	33
	0.3†	1.5†	1.5†	0.35†	0.03†	0.025†		0.06Al	64	72	4.5	7.4	17
								0.06Al, 0.1Ca	66	84	9.7	14.5	19
								0.06Al, 0.1Se	67	87	22.0	30.9	41
Nickel Silicon	0.2†	1.5†	0.7†	1.3†	0.03†	0.025†		None	57	90	9.0	—	
	0.2†	1.5†	0.7†	1.3†	0.03†	0.025†		0.1Se	62	84	28.0	46.0	21
Nickel Vanadium	0.3†	1.5†	0.7†	0.35†	0.03†	0.025†	0.01†	None	66	84	15.5	22.7	
	0.3†	1.5†	0.7†	0.35†	0.03†	0.025†	0.1†	0.05Ca, 0.03Se	65	84	24.7	41.3	40

*Heavy Sections were 3 in. keel molds with the tensile bar taken from center of section.
NOTES[2]: †Indicates estimated analysis.
All Heat Treatment: 1900°F; 1600°F; 1200°F; 3 hrs. each, air cooled.

use about 0.1 per cent of high-priced selenium to obtain sulphide coalescence in steels of normal sulphur. Accordingly, the problem was presented of discovering whether the amount of selenium required could be reduced, and whether this could be done by employing a combination of one or more other elements with selenium. As a result of experimentation, it was discovered that calcium could be employed together with smaller amounts of selenium to produce the desired results.

Table 1 shows some of the satisfactory results of using calcium, added as calcium silicide. Thus, it will be observed from Table 1 that 0.1 per cent calcium and 0.02

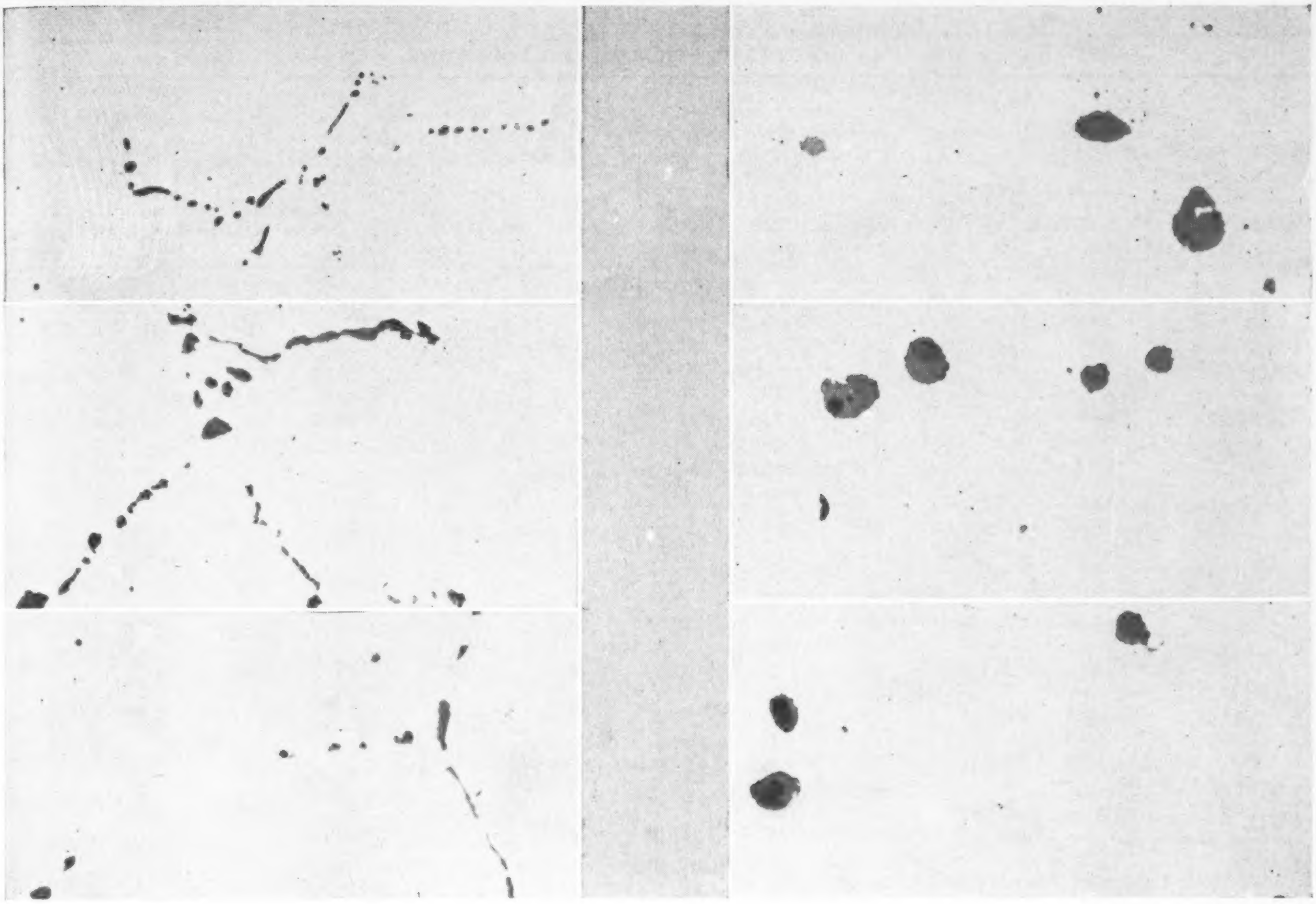

Fig. 6—Sulphide Coalescence promoted by Calcium Selenium in various Cast Steels. X500.
Top—Nickel-Vanadium Steel, induction furnace heat. (Left)—0.02 per cent Aluminum. (Right)—0.02 per cent Aluminum, 0.05 per cent Calcium, 0.03 per cent Selenium.
Center—Nickel-Molybdenum Steel, induction furnace heat. (Left)—0.02 per cent Aluminum. (Right) —0.02 per cent Aluminum, 0.05 per cent Calcium, 0.03 per cent Selenium.
Bottom—Nickel-Manganese Steel, arc furnace heat. (Left)—0.02 per cent Aluminum. (Right)—0.02 per cent Aluminum, 0.05 per cent Calcium, 0.03 per cent Selenium.

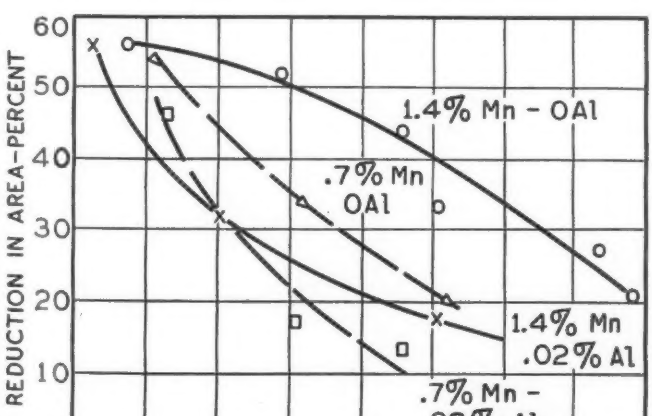

Fig. 7—Relation between Manganese, Sulphur, and Ductility in Nickel Cast Steel finished with 0.05 per cent Calcium, 0.03 per cent Selenium.

per cent selenium were as effective as 0.1 per cent selenium alone for improving the ductility of aluminum-killed steel.

It is evident also that, in these quantities, both elements are necessary for high ductility. A micro-examination showed that calcium shortened and thickened the sulphide links of aluminum-killed steel and that selenium provided the stimulus for complete agglomeration. While it is possible to combine calcium and aluminum without selenium for high ductility,[2] the calcium must precede the aluminum addition and then will function only in an oxidized heat. Only with selenium does it appear possible to agglomerate the sulphides in a steel otherwise destined to have the intergranular type.

Calcium-Selenium Deoxidation Tested

Two other sulphide forming elements, titanium and zirconium, did not appear to replace part of the selenium successfully, and the results of these tests appear in Table 2. These steels had low ductility even when no aluminum was used, and they contained intergranular sulphides.

This deoxidation procedure was tested in a variety

Table 6.—Mechanical Properties of Selenium Containing Steels Produced in Seven Commercial Foundries

FOUNDRY "A"

Furnace: Basic Open Hearth
Heat Treatment: Normalized and Drawn

Heat No.	Ladle Addition, percent			Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong., percent	Red. in Area, percent	Composition, per cent C	Mn	Si	P	S
	Aluminum Titanium											
	Al	Ti										
1	0.025	0.045		74	104	27.5	50.3	0.37	1.34	0.47	0.028	0.021
2	0.025	0.045		67	95	24.5	44.9	0.36	1.42	0.43	0.032	0.024
				64	92	25.0	46.6					
3	0.05	0.045		67	94	25.8	49.7	0.36	1.63	0.47	0.042	0.026
				67	92	27.3	50.3					
	Calcium Aluminum Titanium											
	Al	Ca	Ti									
4	0.037	0.063	0.045	69	100	17.3	26.2	0.38	1.60	0.47	0.034	0.025
				69	101	20.0	33.8					
5	0.037	0.063	0.045	66	91	8.7	13.4	0.37	1.74	0.60	0.018	0.020
				65	88	7.5	7.8					
6	0.037	0.063	0.045	67	99	19.0	28.5	0.39	1.60	0.50	0.026	0.021
				67	99	21.8	32.5					
7	0.05	0.063	0.045	59	95	23.5	53.6	0.39	1.45	0.56	0.023	0.021
				63	95	28.0	54.7					
8	0.05	0.063	0.045	63	93	28.5	52.5	0.36	1.54	0.57	0.027	0.019
				65	93	26.5	50.9					
9	0.05	0.063	0.045	66	95	28.0	47.8	0.34	1.51	0.43	0.028	0.024
				—	94	28.5	48.0					
10	0.05	0.063	0.045	70	97	22.5	36.0	0.35	1.53	0.53	0.037	0.014
				70	96	25.5	45.4					
	Calcium Aluminum Selenium											
	Al	Ca	Se									
11	0.05	0.095	0.05	61	93	30.0	56.3	0.33	1.33	0.49	0.028	0.018
				62	93	29.2	54.1					
12	0.05	0.063	0.05	59	90	27.3	51.4	0.29	1.45	0.52	0.029	0.019
13	0.062	0.063	0.05	67	96	22.0	33.5	0.37	1.56	0.46	0.038	0.024
				No test—holes in coupon								
14	0.062	0.063	0.05	67	97	24.5	47.5	0.38	1.68	0.50	0.025	0.023
				67	98	24.5	44.6					
15	0.062	0.063	0.05	68	97	27.0	52.5	0.33	1.50	0.50	0.035	0.024
				67	96	27.0	49.5					
16	0.062	0.095	0.05	62	90	28.5	53.3	0.31	1.57	0.55	0.029	0.023
				60	89	28.5	53.3					
17	0.062	0.095	0.05	60	89	29.0	53.6	0.33	1.60	0.31	0.011	0.024
18	0.062	0.095	0.05	62	92	28.5	52.8	0.32	1.38	0.29	0.016	0.022
				61	92	28.5	52.8					

Table 6.—*Continued*

FOUNDRY "B"

Furnace: Acid Electric.

Nominal Composition: C 0.35 0.45; Mn 1.4 1.6; Mo 0.45 0.55; Si 0.3 0.5

Heat Treatment: Double Normalized and Drawn.

Heat No.	Ladle Addition, Percent	Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong., percent	Red. in Area, percent
1	Si....................	93	110	20.5	40.2
2	Si....................	90	111	17.0	28.2
3	0.037Al, 0.1Ca, 0.05Se.	85	113	20.5	42.5
4	0.1Ca, 0.05Se.........	83	112	21.7	44.0
5	0.1Ca, 0.05Se.........	87	116	18.0	35.0
6	0.037Al, 0.1Ca, 0.05Se.	83	111	20.5	37.0
	Desired Properties.....	80	100	18.0	25.0

Table 6.—*Continued*

FOUNDRY "C"

Furnace: Basic Electric.

Nominal Composition: C 0.30; Mn 1.5; Cr 0.45; Mo 0.35; Si 0.50

Heat Treatment: Homogenized, Quenched and Drawn.

Item No.	Ladle Addition, percent	Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong., percent	Red. in Area, percent	Izod Impact, ft. lb.	No. Heats Tested
1	0.08Ca, 0.05Se	143	152	15.0	36.8	30.8	5
2	0.25FeTi	146	155	13.9	28.7	36.5	4
3	0.08Ca	142	152	12.5	30.4	34.9	2
4	0.15FeTi, 0.05Al	134	148	12.0	28.7	31.6	5
5	0.05Ca, 0.10Al	136	148	11.2	23.8	34.4	7
6	0.10Al	134	146	11.3	24.0	27.4	12
7	—	129	138	10.0	17.2	31.3	1

TABLE 6.—*Continued*

FOUNDRY "D"

Furnace: Basic Electric.

Nominal Composition: C 0.35 .45 Cr 0.80 1.0 Mo 0.15 .20 Mn 0.70 .90 Si 0.30 .50

Heat Treatment: Homogenized, Oil Quenched and Drawn.

Heat No.	Ladle Addition, percent	Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong., percent	Red. in Area, percent
1	—............	165	175	5.0	11.5
		172	185	4.5	9.0
2	0.1 mill scale...	155	165	7.0	11.5
		165	163	6.0	13.0
3	0.1 mill scale...	164	179	8.5	14.5
		165	177	6.5	11.0
4	0.1 Grainal.....	177	188	6.0	16.0
		163	170	7.5	19.1
5	0.1 Grainal.....	157	165	6.0	17.0
6	0.1 Grainal.....	183	191	5.0	12.5
		166	164	6.0	9.0
7	0.1 Silcaz......	165	179	5.0	13.5
		157	179	7.5	17.5
8	0.1 Se.........	172	179	11.0	34.0
		177	185	13.0	34.0
9	0.1 Se.........	171	176	12.5	36.0
10	0.1 Se.........	178	183	6.0	13.0
		178	184	9.5	24.5
11	0.1 Se.........	164	169	10.5	32.5
		165	170	10.0	29.0
12	0.1 Se.........	168	176	8.5	17.0
		173	181	7.0	17.0
13	0.1 Se.........	172	183	11.5	28.0
		174	184	8.0	16.5
14	0.1 Se.........	180	186	7.0	9.5
		175	183	7.0	20.2
	Desired Properties		170-180	7.0 min.	12.0 min.

TABLE 6.—*Continued*

FOUNDRY "E"

Furnace: Acid Electric.

Composition: C 0.39 Cr 1.08 Mo 0.21 Mn 0.90 Si 0.47 P 0.036 S 0.033

Ladle Addition, percent	Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong., percent	Red. in Area, percent
Normalized, Quenched and Tempered				
Plain...............	170	185	5.6	15.7
0.10 Al..............	173	186	6.4	17.9
0.10 Se..............	170	182	9.5	26.9
0.20 Grainal.........	180	190	4.0	8.0
Homogenized, Normalized, Quenched and Tempered				
Plain...............	173	188	9.3	23.7
0.10 Al*.............	156	173	3.1	4.5
0.10 Se..............	170	186	11.0	31.2
0.20 Grainal*........	177	193	5.0	10.8

All results are an average of 4 tests, except * which are an average of 2 tests.

TABLE 6.—*Continued*

FOUNDRY "F"

Furnace: Electric, type not reported.

Nominal Composition: C 0.35 Ni 1.3 Cr 0.8 Mo 0.3 Mn 0.8 Si 0.45 P 0.03 S 0.03

Heat No.	Ladle Addition, percent	Yield Str., 1000 psi	Tens. Str., 1000 psi	Elong., percent	Red. in Area, percent	Izod, ft. lb.
	Normalized, Oil Quenched and Tempered					
1	0.08Al, 0.057Se	131	145	10.5	18.1	13
	0.057Se	137	151	13.5	35.7	21
	0.033Ca, 0.057Se	137	151	13.0	32.4	20
	0.08Al, 0.025Ca	135	147	12.5	30.2	20
2	0.08Al, 0.057Se	152	165	5.0	11.0	9
	0.057Se	151	163	13.0	37.0	13
	0.033Ca, 0.057Se	156	165	11.0	29.0	14
	0.08Al, 0.025Ca	149	160	9.5	22.0	13

NOTE: Calcium added as CaSi.

TABLE 6.—*Continued*

FOUNDRY "G"

Furnace: Acid Electric.

Composition: C 0.23 Mn 0.64 Si 0.39 P 0.029 S 0.031

Heat Treatment: Normalized and Drawn.

Heat No.	Ladle Addition percent	Yield Str., 1000 psi	Tens, Str., 1000 psi	Elong., percent	Red. in Area, percent
1	0.025Al..............	51	75	29.0	45.0
	0.025Al, 0.05CA, 0.03Se	58	77	32.0	53.0
	0.025Al, 0.10Ca, 0.05Se	56	78	30.0	45.0
	Induction Furnace Heats: Normalized and Drawn.				
	Composition: C .32 Mn 1.39 Mo .24 Si .44 P .034 S .038				
2	—.................	—	116	18.5	49.0
	0.10Al..............	89	107	20.0	39.0
	0.10Al, 0.10Ca, 0.05Se..	90	107	20.0	42.0
	Composition: C .25 Ni .20 Cr .59 Mn .74 Si .19 P .03 S .037				
3	—.................	92	111	18.5	52.0
	0.03Al, 0.10Ca, 0.06Se.	85	102	23.0	53.0

NOTE: All test coupons 1 in. to 1¼ in. section.

of compositions finished with 0.02 per cent aluminum, recognized as promoting poor sulphide dispersion and low ductility in cast steel. The tensile results in Table 2, obtained on well-fed 1-in. sections, show that 0.05 per cent calcium and 0.03 per cent selenium substantially improved induction-furnace steels.

Elongation was improved and the reduction in area raised from 22-29 per cent in the aluminum-deoxidized steel, to over 50 per cent by the selenium treatment. In most cases the impact resistance was doubled. The only steel not improved by selenium was a manganese-titanium composition, which verifies the earlier obser-

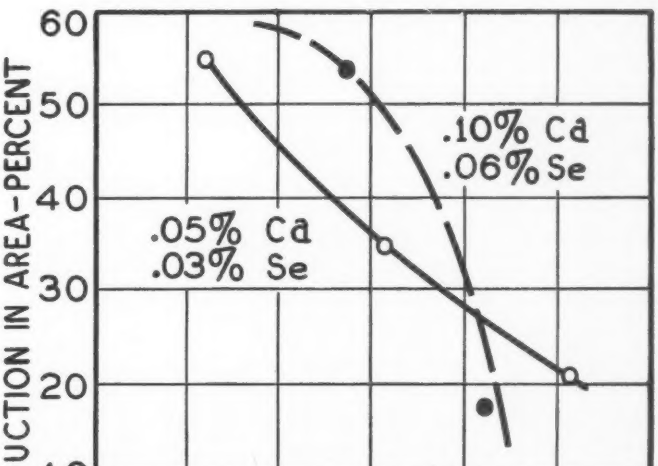

Fig. 8—Relation between Calcium Selenium, Sulphur, and Ductility of Nickel-Manganese Cast Steel.

vation that selenium cannot coalesce sulphides in the presence of titanium.

The results obtained in direct-arc-furnace heats, shown in Table 4, develop the same trend as the induction heats, although the ductility of aluminum-killed fractions is somewhat higher in the arc-furnace steels. A few examples of the sulphide coalescence provided by selenium in both types of steel are shown in Fig. 6.

Relation Between Manganese and Sulphur

It became evident during this study that manganese increased the tolerance for sulphur and that steels with high manganese content were more susceptible to improvement with calcium-selenium deoxidation than those with lower levels of manganese. The results in Fig. 7 demonstrate this point and indicate that greater ductility can be achieved with 1.4 per cent manganese than with 0.7 per cent, especially at sulphur levels above 0.04 per cent. The data also indicate that steels finished with 0.02 per cent aluminum were considerably more sensitive to high sulphur contents than aluminum-free steels.

An increase in calcium and selenium, from 0.05 per cent and 0.03 per cent to 0.10 per cent and 0.06 per cent, respectively, increased the tolerance for sulphur in low-manganese steels, as shown in Fig. 8. One point that should be recognized in connection with these data is that the ductility, especially at high sulphur levels, is probably not the maximum obtainable because of the production method. These heats were finished with calcium-selenium, and sulphur then was added to successive fractions. Oxidation losses occurring during this procedure undoubtedly reduced the ductility. The data demonstrate trends but cannot be used to predict the ductility of high sulphur steels.

Effectiveness in Heavy Sections

It is well known that increases in section size are detrimental to the properties of cast steel, particularly to ductility. Segregation and a greater susceptibility to poor sulphide dispersion contribute to deterioration of ductility. It was of interest, therefore, to make a few tests using a keel mold of 3-in. section to determine how well selenium could deal with the more severe conditions existing in heavy sections.

In order to appreciate the powerful effect of section size on cast steel it should be recognized that the nickel-manganese and nickel-vanadium steels in Table 5 which received no ladle treatment, would have developed at least 50 per cent reduction in area if cast in the regular test mold of 1-in. section. Selenium and calcium-selenium greatly improved the heavy section ductility of nickel-manganese steel and, in fact, improved it to the same extent as that achieved in the steel which was heavily oxidized. The latter was oxidized so heavily that it effervesced slightly during solidification. Aluminum sharply reduced ductility, which again was improved by selenium although not to the level achieved in the aluminum-free material.

Grain Refinement Promoted

Thus these few tests indicate that selenium is able to coalesce sulphides under the severe conditions existing in heavy sections, as shown in Fig. 9, and the author

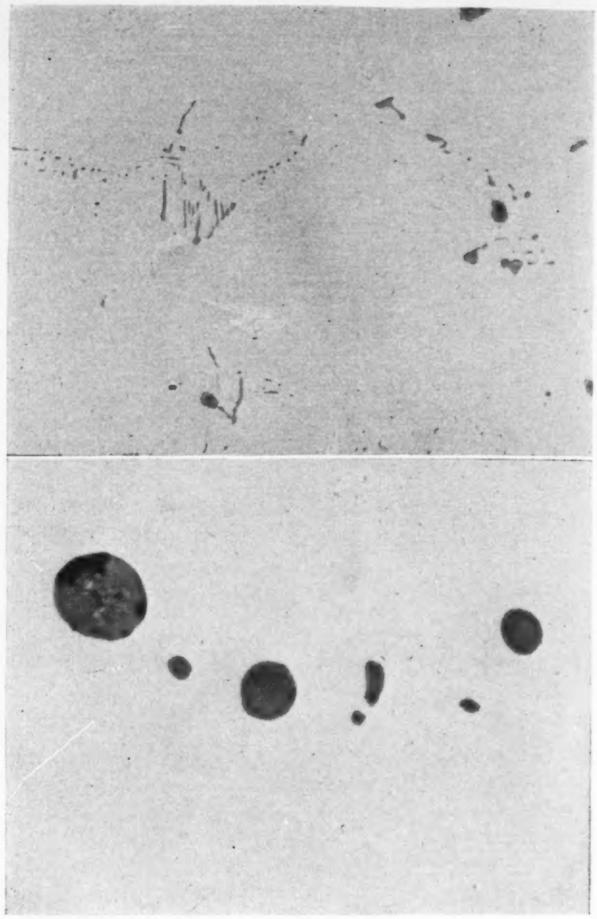

Fig. 9—Sulphide Coalescence by Selenium in 3-in. cast sections of Nickel-Manganese Steel. (Above)—As melted, X250. (Below)—0.1 per cent Selenium, X500.

suggests that it should be especially useful in this connection.

Selenium refines the grain size of steel. Grain sizes of 6 or 7 were obtained in steels containing 0.1 per cent selenium, and the normalized grain size of a steel containing 0.05 per cent calcium and 0.03 per cent selenium is compared to a similar silicon-killed steel in Fig. 10. Thus the usual benefits of fine-grained steels, such as a high ratio of yield to tensile strength and good impact resistance, are obtained in selenium containing steels. Grain refinement usually is associated with strong carbide or oxide forming elements, and it was rather surprising to find that selenium, a weak deoxidizer, refined the grain in steel.

Tests with Commercial Steels

Selenium was tested in seven foundries in steels melted in acid and basic electric, basic open hearth, and induction furnaces. The steels ranged from plain carbon with tensile strengths of 75,000 psi to quenched alloy steels of 180,000 psi. Results are given in Table 6, which also includes results obtained on other deoxidation procedures that were available.

In Foundry A, only one of eight open-hearth heats finished with calcium selenium had low ductility, while three heats of seven representing another deoxidation method had low ductility. Moreover the selenium heat of low ductility was obviously of poor quality since

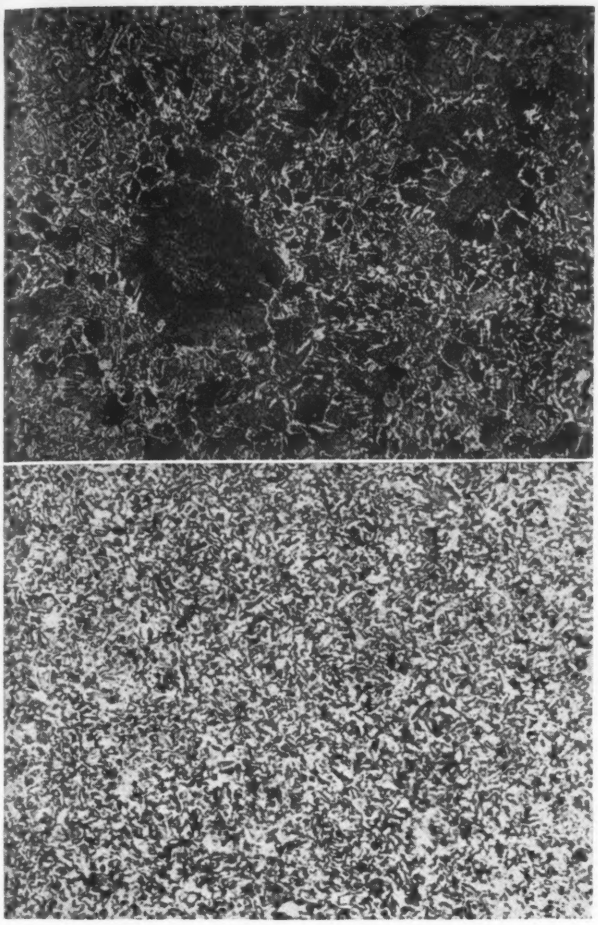

Fig. 10—Grain refinement promoted by Selenium in normalized Nickel-Manganese Steel. Heat treated 1 hr. at 1600 F. and air cooled. Micrographs at X100, nital etch. (Above)—No ladle addition. (Below)—Addition of 0.05 per cent Calcium, 0.03 per cent Selenium.

other test bars from it contained gas holes, which is unusual for a steel whose ladle additions included 0.06 per cent aluminum. All four of the selenium, acid-electric heats from Foundry B met the required properties, while one of the two heats deoxidized with silicon alone passed specification.

The tensile results on basic electric steels from Foundry C are significant because they were made under closely controlled melting conditions and the results for each deoxidation procedure are the average of several heats. Calcium-selenium deoxidation developed the best ductility and was superior to six other deoxidation methods.

Foundries D and E dealt with high-strength, quenched-and-drawn steels, although one used basic-electric and the other acid-electric furnaces. The selenium heats again showed better ductility and at the same time were more consistent in promoting ductility than steels finished in other ways.

Foundry F obtained good ductility with calcium-selenium steels of high strength, which was better than that developed by aluminum-selenium deoxidation. However, the amount of selenium used was too low and an increase from 0.05 per cent to 0.1 per cent probably would have developed high ductility with aluminum containing steels. Foundry G had no steels of low ductility regardless of the deoxidation procedure used, and consequently provided little opportunity for improvement via calcium selenium.

Methods and Amount of Additions

Selenium may be added to the tapped stream in lump form or as ferro-selenium. The recovery with pure selenium ranges from 65 per cent to 80 per cent while the ferroalloy has a greater recovery of 85 to 95 per cent. Somewhat more fuming occurs with the lump selenium, although the quantities used are so small that this is not considered an objectionable feature from a foundry point of view.

In these tests calcium always was added as calcium silicide. In using calcium silicide, care should be taken to assure that it is carried beneath the surface by the tapped stream, or else attached to a rod and submerged for its effective addition.

Calcium selenium is preferred to selenium alone for finishing cast steel because it is cheaper and as fully effective. The proper amounts seem to be between 0.05 per cent Ca–0.03 per cent Se and 0.10 per cent Ca–0.06 per cent Se, and depend on the sulphur content and another factor not clearly identified. For a long time it seemed certain that 0.05 per cent Ca–0.03 per cent Se were sufficient to promote high ductility under all circumstances. However, with one lot of melting stock that arrived at the laboratory when this study was nearly complete, 0.10 per cent Ca and 0.06 per cent Se were required for high ductility in aluminum-killed steel.

One reason for the greater amount of selenium required was that its recovery in the new melting stock was lower than it had been in the old. There were indications that the oxide content on melt down influenced the selenium recovery and that the more highly oxidized heats favored better recovery. This happened in spite of the fact that selenium was added after the aluminum and that the aluminum-killed specimens had the same low ductility regardless of the base metal used and the degree of oxidation on melt down.

The reasons for this behavior are not understood but are important only from an economic point of view, since good ductility could be obtained with all base materials. Consequently the amount of addition should be varied with a particular set of melting conditions to determine the minimum requirement. The quantities recommended for initial runs are 0.08 per cent calcium and 0.05 per cent selenium.

General Advantages

The comprehensive tests of selenium and calcium selenium in both laboratory and commercial melts develop two features of this addition agent. The ductility of selenium-containing steels is better than that of selenium-free steels, and selenium steels of low ductility occur less frequently than those deoxidized in other ways. From a commercial standpoint these features mean higher quality steel as well as fewer heats lost through failure to pass specification.

There appears to be little question that selenium steels are less sensitive to melting technique than those deoxidized in other ways. The fact that good ductility was achieved in different compositions melted in all

types of furnaces testifies to this thought. Such an advantage is important from an operating standpoint, since it allows wider latitude in furnace operation and, perhaps, requires less skill on the part of the melter. Although such an intangible factor cannot be accurately evaluated, it nevertheless is real and is a corollary to the fact that selenium-containing steels of low ductility occur less frequently than selenium-free steels.

Selenium increases the cost of deoxidation and the extent of its use probably depends on the quality of the steel desired, the specifications to be met and the frequency of low-ductility heats that can be tolerated.

Conclusions

1. Selenium has the specified ability to coalesce the intergranular sulphides in cast steel and thereby improve its ductility. In addition, it refines the grain and is a mild deoxidizer.

2. It appears to combine with the sulphides in steel and promote their rejection from solution before solidification is complete. Manganese-sulphides are located at the interface of the primary dendrites and the inter-dendritic filling, in contrast to inter-granular sulphides which are rejected from the last freezing liquid in the center of the inter-dendritic filling.

3. Calcium can be substituted for part of the selenium without sacrifice of the sulphide-coalescing ability, Zirconium and titanium did not successfully replace part of the selenium.

4. The addition of 0.05 per cent calcium and 0.03 per cent selenium approximately doubled the reduction in area and the toughness of a variety of experimental cast steels, with well defined intergranular sulphides intentionally produced by the addition of 0.02 per cent aluminum.

5. Selenium and calcium selenium coalesced the sulphides and greatly improved the ductility of cast steel in heavy sections. It should be especially useful in this connection, since the problem of obtaining ductility in cast steel is accentuated as the section size is increased.

6. Calcium-selenium finished steels have only slightly better ductility than silicon-killed steels at a given sulphur level. The important difference is that selenium promotes globular sulphides in over-killed steels of low oxide content, thus readily permitting the production of sound, ductile castings. Silicon-killed steels, on the other hand, require a relatively high oxide content for globular sulphides and are therefore susceptible to gassiness.

7. Manganese increased the tolerance for sulphur in calcium selenium steels, while aluminum reduced it.

8. Calcium selenium and selenium developed good ductility in a variety of commercial steels ranging from 75,000 psi to 180,000 psi tensile strength, melted in electric and open-hearth furnaces. The selenium-containing steels developed better ductility and, at the same time, fewer heats with low ductility than other methods of deoxidation.

9. Selenium appears to permit broad latitude in melting conditions and therefore should assist in the consistent production of high quality cast steel.

Acknowledgments

The author is indebted to Norman B. Pilling for helpful criticism and permission to publish the results; to John T. Eash for suggestions and cooperation during the investigation; and to the personnel of the foundries which conducted the tests on the commercial steels.

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[2]A. P. Gagnebin, *The Effect of Deoxidation Treatments on the Ductility of Cast Steels,"* TRANSACTIONS A.F.A. (1938) vol. 46, p. 133.

A.F.A. Educational Booklets Are Now Available Gratis for Industrial Use

TWO FREE COLORFUL booklets recently issued by the American Foundrymen's Association are being acclaimed by foundrymen, educators, personnel directors, and employment bureaus. In convenient 6 x 9 inch size, these booklets are attractively printed and illustrated in red and black. "THE FOUNDRY IS A GOOD PLACE TO WORK," is an illustrated reprint of the booklet by the same name which was so well received a year ago. The new edition is helpful in giving anyone a general non-technical picture of the castings industry. Some of the topics covered in this booklet are indicated by the subject headings; Everybody needs castings; How castings are made; The foundry needs workers now; The foundry offers employment everywhere; The foundry offers training; Opportunities for veterans; The foundry offers good wages; The foundry offers a future; How to get a job in a foundry.

The second booklet, "MILITARY ASSIGNMENTS RELATED TO THE FOUNDRY INDUSTRY," is especially helpful to veterans looking to the foundry industry for work and to personnel directors and placement counselors assisting veterans to find employment. This booklet describes how veterans with service-acquired skills fit into 46 different jobs in the castings industry. These jobs are described briefly and related to many of the 39 army and 31 navy occupations listed in the booklet.

As a test, a copy of each of the two booklets was sent to approximately 100 employment offices in the Chicago area. Immediate requests came back for up to 60 copies of each booklet to be used in employment counseling, to train interviewers, and to be used as a general reference on the opportunities available for careers in the foundry industry.

Booklet Distribution

Chapter educational committees can give these booklets wider distribution by placing copies in local employment bureaus, in the hands of plant personnel directors, and in public and school libraries.

Both booklets are available to anyone in reasonable quantity at no cost. Ask the American Foundrymen's Association, 222 West Adams Street, Chicago 6, for "THE FOUNDRY IS A GOOD PLACE TO WORK" and "MILITARY ASSIGNMENTS RELATED TO THE FOUNDRY INDUSTRY" and use them for furthering the industry.

PLANNING COMMITTEE WORKING ON MICHIGAN STATE MEETING

ARRANGEMENTS ARE now being made by the Planning Committee for the Michigan State College Foundry Conference to be held Friday, October 31 and Saturday, November 1. This meeting promises to be one of the largest foundry conferences ever to be held at the East Lansing, Mich., school. C. C. Sigerfoos, Michigan State College, is the conference chairman.

Four A.F.A. chapters, Saginaw Valley, Western Michigan, Detroit and Central Michigan, as well as the Michigan State College, are co-operating in staging this affair. The meeting will be opened Friday morning with an address of welcome by a college representative followed by a number of technical sessions dealing with steel, cupola operation, sand and non-ferrous. The conference will be climaxed Saturday afternoon by a football game. The conference dinner is scheduled for Friday evening.

Personnel of the Planning Committee is: F. S. Brewster, Dow Chemical Co., Bay City, Mich., and M. V. Chamberlin, Dow Chemical Co., Saginaw, Mich., representing the Saginaw Valley chapter; Charles Locke, Western Michigan Steel Foundry Co., Muskegon and D. A. Paull, Sealed Power Corp., Muskegon Heights, representing the Western Michigan chapter; R. G. McElwee, Vanadium Corp. of America, Detroit and Earl E. Woodliff, Foundry Sand Service Engineering Co., Detroit, representing the Detroit chapter; Fitz Coghlin, Jr., Albion Malleable Castings Co., Albion, representing the Central Michigan chapter and L. G. Miller, H. L. Womochel, N. C. McClure and C. C. Sigerfoos representing the Michigan State College.

The conference program has been tentatively scheduled as follows: Friday morning registration and an address of welcome; a noon luncheon; and three technical sessions in the afternoon. Two of these meetings are round table discussions dealing with heading and feeding steel castings and operating the cupola under materials difficulties, while the third is a general session on mechanization in the foundry. Friday evening the conference dinner will be held. Three technical meetings are planned for Saturday morning concerning chemically treated foundry sands, selection and use of core oils and binders and non-ferrous casting defects.

1947 TRANSACTIONS TO BE AVAILABLE TO ALL MEMBERS

FOLLOWING RECENT action of the A.F.A. Board of Directors, the Association wishes to announce a change in the policy relative to the distribution of the 1947 TRANSACTIONS, Bound Volume number 54. Effective with the publication of this book, all paid-up company and sustaining members on record as of the date of publication will receive one cloth bound copy of the 1947 TRANSACTIONS gratis on request. Similarly, all personal members will receive a paper-bound copy gratis on request. Cloth bound copies will be available to all members at $2.00 per copy. Non-members may obtain cloth bound copies of TRANSACTIONS at $15.00 per copy.

The 1947 TRANSACTIONS will be published as a limited edition, based upon pre-publication requests from the membership. Prior to the publication date of the bound volume each A.F.A. member will receive a notice and application form advising of the book's availability under the conditions listed.

This is the first time in several years that this annual edition has been available to the membership gratis. It will contain the complete proceedings of the Golden Jubilee Foundry Congress held in Cleveland, May 6-10, 1946, including the technical papers and discussions presented at the various sessions. As last year the book will be 8½ x 11 in.

Annual Institute Meeting Held in London

THE BRITISH Iron and Steel Institute held their annual meeting May 14-16 in London. Among the subjects covered was a symposium on the hardenability of steel and the second Hatfield Memorial Lecture by Dr. C. Sykes, Brown-Firth Research Laboratories, Sheffield, who had as his subject "Steels for Use at Elevated Temperatures."

Harold Hauslein, Harold Hauslein & Associates, Chicago, giving the chapter chairman delegates, who were present at the Chapter Chairman Conference last month, a few inside pointers on how to handle a meeting.

THE ROLE OF INTELLIGENCE IN OUR LABOR RELATIONS

E. B. Gallaher
Norwalk, Conn.

I WONDER HOW MANY OF US have given thought to the intelligence of those whom we employ in our shops and the important part it plays in our labor relations?

During World War I, the Army examined the mental levels of some 1,700,000 soldiers and classified them in groups on a point basis from A to D-minus.

I think we will all admit that this large number of men, drawn from all walks of life and from every part of the United States, would fairly represent a reasonable cross-section of the population of our country and that therefore a study of the intelligence of this group would reflect very accurately the intelligence of the people we employ—both men and women.

Distinct Characteristics

The first thing we must do is to get clearly in our minds that intelligence and knowledge are two separate and distinct characteristics. A person may have a great deal of knowledge and little intelligence, while another may have high intelligence and little knowledge. At first I will talk of intelligence only and the important part it plays in our labor relations; later I will speak of knowledge.

Let's look, for a moment, at the Army's classification of intelligence of these 1.7 million drafted men it examined. From this classification, we find that 70 per cent have the intelligence of children of 14 years or under, divided as follows: There are 10 per cent rated D-minus, with very inferior intelligence; D, 15 per cent, with inferior intelligence; C-minus, 20 per cent, low intelligence; C, 25 per cent, average intelligence of a child of 12 to 14 years of age.

This is Part I of a paper reprinted from the Army Ordnance Association Business Letter of January 1947. The second and concluding installment will appear in the September issue.

This is an appalling situation to contemplate, but it must be dealt with.

In the more intelligent group, there are: C-plus, 16½ per cent, higher than average intelligence; B, 9 per cent, superior intelligence; A, 4½ per cent, very superior intelligence.

Thus in large groups of employees it is fair to assume that only 30 per cent will have from higher-than-average to superior intelligence; and of these that only 4½ per cent will have very superior intelligence.

When a child is born it displays no intelligence and, of course, has no knowledge; but as it develops, year by year, it gains both knowledge and intelligence.

With normal children, intelligence gains uniformly, year by year, until they reach maturity. However, it is found that some children will gain in intelligence uniformrly until they reach a certain age, when mental development ceases. In other cases, a child will develop mentally faster than the average, and his mental capacity may even carry him into the brilliant or the exceptionally bright classification.

Intelligence is something we inherit—it is nothing that can be acquired; and when a child ceases to develop mentally it means that the brain cells have stopped their normal growth.

Professor Goddard, formerly of Princeton University, explains it as follows: "Stated in its boldest form, our thesis is that the chief determiner of human conduct is a unitary mental process which we call intelligence; that this process is conditioned by a nervous mechanism that is inborn; that the degree of efficiency to be attained by that nervous mechanism and the consequent grade of intelligence or mental level for each individual is determined by the kind of chromosomes that come together with the union of the germ cells; that it is but little affected by any influence, except such serious accidents as may destroy part of the mechanism."

In other words, the majority of human beings develop mentally to some given point where development stops, and for the rest of their lives their level of intelligence is fixed and remains stationary—they can acquire little further intelligence.

Knowledge vs. Intelligence

Knowledge, on the other hand, can be acquired even by those of low mentality, and often we find people who would be classified as having a C mentality but who have a great deal of knowledge along some special line.

Thus we find many doctors, ministers, mechanics, stenographers, bookkeepers, office workers, buyers, storekeepers, foremen, to say nothing of the vast horde of politicians, from the very top in our National Government, right through our states and cities down to our smallest communities, who may be really skilled at their particular jobs but who possess only average or subaverage intelligence.

These people have acquired their skill slowly through trial and error,

but they lack the mental ability to go beyond a definite point.

A person of low intellect has not the power to say: "I don't know—show me," for they have an inferiority complex; nor can they initiate anything—they can follow, but not lead. Notwithstanding this, they often are very conceited and try to make others believe they have intelligence and knowledge beyond their mental level.

Leadership Needed

Another trait of persons of low intellect is to distrust and often dislike people having a superior intellect—they don't necessarily have anything against them, but they just naturally distrust and dislike them.

These people of low intellect, with few exceptions, are not vicious—they want to do the best they can. They are more anxious for security than anything else, they want help and advice from someone they can trust, they want a friend who can lead them and tell them what to do.

Another thing we must get clear in our minds is that bright children do not always come from prosperous or even intelligent parents. Some of the brightest people we have ever known have come from farms or from families of ordinary circumstances, and, likewise, we find executives of big corporations who have obtained their jobs through influential parents or friends but who would not rate mentally as high as some one doing menial work.

We often find a brilliant child of parents who would be rated as having only normal intelligence. In such cases, if we look beyond the parents we are apt to find immediate ancestors who were highly intelligent.

We must take every person for what they are, give them the opportunity to expand to the limit of their intelligence, and provide them useful work which they are competent to perform.

Why We Have Labor Troubles

Unhappiness among workers is caused mainly by two conditions: (1) they are assigned to do work which is beyond their mental capacity and are continually being pushed to produce more, or (2) they are given jobs that are beneath their mental capacity, so that they feel they are being held back and not allowed to utilize their full ability.

In either case we have a dissatisfied employee—the first one because he is always afraid of losing his job and the second because he feels the job is beneath him.

I think we will all agree it is up to industry to provide jobs for as many workers as possible, regardless of their mental level.

If this thesis be accepted, then the various "incentive" plans fail, because at least those I have seen offer a bonus for added production beyond an established minimum, with the result that workers of higher intelligence are thus segregated from those of lower intelligence who ultimately drop out because they cannot make the grade.

This system assures the company the employment of those of higher intelligence, but it fails to make provisions for those in lower classifications.

To carry such a plan to the end point, only 30 per cent of our workers could qualify for jobs, and 70 per cent would remain permanently unemployed. Industry would be faced with an enormous unemployment problem, and we all know where this would lead.

From my own experience, I know that various kinds of jobs require workers of different mental capacities, and the only way to obtain maximum results is to classify each job according to the intelligence required to do the work properly.

What Can We Do About It?

Naturally, we should first resurvey our management to make certain that we have men of high intelligence directing our affairs, and this should start at the very top and carry right on through the department heads.

It goes without saying that we must have leaders who are more intelligent than those whom they assume to lead.

All top men should have an A classification if they are to plan and direct the institution successfully. Department heads and foremen should have at least a C-plus or a B classification, depending upon the importance of their jobs.

Here, right away, is presented the most difficult problem of selection, as we must differentiate closely between intelligence and knowledge.

Many men have gained advancement in our industries and are considered bright because they have accumulated a great deal of knowledge. Because of this we have failed in many cases to realize that they are of only average or subaverage intelligence.

If men are selected to be leaders, they must have the intelligence necessary to lead, as well as the knowledge; otherwise a gradual disintegration will take place in industry. This is understandable, because there are probably bright or brilliant men working under those less capable, which always breeds resentment and acts as a damper on their efforts.

A man who is being led must respect the intellect and ability of the person who is over him.

Segregation of Workers

Here is a suggestion for handling the workers in the shop—those who might be classed D-plus, C-minus, C, and C-plus. People in these classifications form the vast bulk of workers and those who are the most difficult to handle.

As previously stated, these people have to be led—they will initiate little. They are most concerned with their own security. They want to work, and they want to do their best, but they often feel they are being pushed around.

Have you ever considered that people seek their friends among folks of their own mental level? Well, what kind of people are you most comfortable with? Would you feel comfortable in the company of people having the intelligence of children of 14 years or under? Or, if you are a highly intelligent person, would you feel comfortable with one of the few so-called brilliant persons who talked of things away over your head?

Certainly you would not. If you and your friends are highly intelligent people you are happiest when in their company as they "talk your language."

Finding Levels

There is a natural segregation among workers according to their levels of intelligence, but, not having recognized this fact, management has mixed them up in all

departments. This is one of the reasons why we are having labor troubles today.

For example, how often do we find in a department doing piece-work some who can do possibly twice as many pieces as others?

What is the usual reaction of the foreman? In most cases he considers the laggards as lazy or unwilling, and he is forever nagging them to do more, because a group of slow workers are more than apt to set the pace for the entire department.

Mental Reactions

Have you stopped to think that these slow workers may be doing the very best they can within the limits of their intelligence, and that nagging and pushing them beyond their ability results in a feeling of lack of security and consequent nervousness and mental unrest?

You will also find that people working in such conditions have developed a hatred for their foreman, and this hatred even extends up to the management which they feel is responsible for demanding more than they can do.

It would not be difficult in most shops to classify operations on an intelligence basis. That is to say, there are certain jobs of, say, assembling a few pieces which could easily be done by a worker having a D-plus intellect.

Suppose enough D-plus persons could be classified and segregated to fill this department and they were set to work on a job which would employ their full mental capacity. Right away we would have a department where every one in it could be friends because they would be of the same mental level. Jealousies would disappear, and every one would be happy at their work.

Trained Foremen Needed

Let us go a step further and see what kind of supervision we should have for these segregated departments.

First of all there should be a foreman of superior intellect who would be carefuly trained to know and fully realize the mental levels of those in his department—who would clearly understand their mental limitations and be willing to cooperate with the management.

This foreman would have to be human and friendly—a man who could inspire confidence, direct, and at the same time make friends with his workers.

If the foreman can gain the confidence and respect of his group and act as a sort of father confessor, he can preach sound doctrines and make them understand that their company is really interested in their welfare. Once this has been accomplished there would be little to fear from labor disturbances.

The trouble with management is that it has paid little attention to the mental reactions of the men.

Yes, they have been given fine medical clinics, clean rest rooms, radios to entertain them while they work. But all this is more or less in the nature of pampering and has little real value as a good-will builder, as demonstrated by the fact that strikes occur in shops which have gone to great lengths to try to satisfy their employees by such methods.

As a matter of fact, pampering employees only makes them more bitter, because it shows a weakness in management and does not answer the real problems.

No, the real underlying reason why we have labor disturbances is, that the workers feel insecure in their jobs; because they, as individuals, have no company leadership at their own level in the person of a sympathetic foreman or leader in whom they have confidence.

These few remarks are not offered as a cure-all, though I believe the thesis to be sound. Either industry will supply intelligent leadership at the workers' level or the labor boss will do it and industry can deal with him.

CHAPTERS RESUME PUBLISHING ROSTERS AND BULLETINS

AMONG THE activities of the thirty-eight A.F.A. chapters, one of the most important projects is compiling an accurate and reliable chapter directory. Members of this committee usually put much effort into publishing a membership list that correctly lists members alphabetically by surname and also by company affiliation. Such a listing is of great aid to all chapter members and also to persons not within the immediate chapter area.

Five chapters have recently published membership directories and these have been Chicago, Northeastern Ohio, Northern California, Oregon and Saginaw Valley. These booklets include chapter committee chairmen and committee personnel, chapter officers past and present, chapter by-laws, chapter history and many other features.

The Western New York chapter is producing a monthly bulletin, *The Sound Caster,* which contains personal items concerning the membership and meeting notes on past and future gatherings of the Western New York chapter. Editor of the publication is F. E. Bates, Worthington Pump & Machinery Co., Buffalo. The name, *The Sound Caster,* was suggested by Fred L. Weaver, manager, Weaver Material Service, Buffalo.

Proceedings of the A.F.A. Southern California chapter's Lecture Course have been printed and incorporates the five papers delivered during the winter course sponsored last year. Four talks were presented by James R. Cady, assistant professor in mechanical engineering, University of Southern California, Los Angeles, and one by E. K. Smith, consulting metallurgist, Beverly Hills. The book is leather bound and well illustrated. Copies available from the chapter.

Chicago Museum Scene For Arts Award Fair

THE FIRST National Industrial Arts Awards Fair will be held in the Chicago Museum of Science and Industry, August 17-September 7.

Students from all parts of the United States, its territories, and Canada, in grades 7 through 12, will exhibit their work. There will be five major classifications: wood, metal, mechanical drawing, printing and model making. A total of 480 prizes and honorable mention awards will be presented.

NEW HEADQUARTERS HOUSE ASTM IN PHILADELPHIA

A CONTINUAL increase in ASTM membership and society activities has forced this organization to move to its own quarters at 1916 Race St., Philadelphia. The new location overlooks Logan Square on Benjamin Franklin Parkway and is perhaps as choice a site as could be found near the Central business district of Philadelphia. It is easily accessible from the several railroad stations and has good local transportation from the principal hotels.

The building is of brick masonry, with stone foundation walls and wood floors. The front portion is faced with limestone. It is three stories high and these three floors together with the basement provide the present office and storage space. The net floor area is about 10,000 sq. ft.

Top of page, left—View of first floor main lobby showing staircase leading to second floor. Receptionist desk at left. Top of page, right—Front view of three story structure housing new headquarters of ASTM, 1916 Race St., Philadelphia. Below—Board room on third floor of ASTM building. Note "modern fold" door when closed provides two smaller rooms for committee meetings.

The front section of the building, on the second floor, is devoted for the most part to committee and board rooms, the executive secretary's offices and members' room. The secretary's offices adjoins the committee room.

On the floor above, the board room extends across the entire front of the building. The whole room is set off by fluorescent lighting in modern fixtures. By drawing the modern fold accordion pleated doors, a third of the room can be enclosed so that two meetings can be accommodated at one time, if the occasion arises.

The headquarters will be equipped with an air conditioning system consisting of seven zones, any of which may be shut off when not in use. Heating is provided by steam furnished by the local utility company. This leaves the entire basement devoted to file and publication storage and also includes kitchenette and other facilities.

The members' room is carpeted and finished in lounge style, and is equipped with writing facilities, telephone, magazine tables and other accommodations for those members of the society who may wish to use them.

The alteration work necessary to convert what was formerly an apartment house into a satisfactory headquarters was quite extensive.

COOPERATIVE EDUCATION

From the Industrial Side

Edgar Hoover Bankard
Assistant Foundry Supt.
Buick Motor Div.
General Motors Corp.
Flint, Mich.

COOPERATIVE EDUCATION is receiving increased attention from educators and industrialists for several reasons. A cooperative program approximates closely the industrial conditions under which an engineer will work on graduation. This develops his ability to get along with people—a quality most necessary and one which cannot be taught in the classroom. From an academic point of view, the cooperative student has an opportunity to apply newly acquired theory soon after it has been gained.

A cooperative engineering program necessarily has three fundamental parts:

1. The engineering program conducted at the school.
2. The organized work experience training program at the plant.
3. The series of industrial and technical reports coordinating the two phases of his curriculum.

It is intended to discuss at length the second phase of the program, i.e., the organized work experience, and show the importance of skillfully arranged work schedules properly put into practice.

In general, certain fundamentals have been recognized in planning work schedules:

1. That the student earn his own way as a worker on the job as far as possible.
2. That work schedules must be set up well in advance to provide a progressive educational experience.

In connection with the first point, it might be said that because of union commitments in many plants the student is not allowed to replace a regular worker. The student does, however, have the satisfaction of being paid for what in many cases is his first job.

The second fundamental is, of course, obvious. Industries entering into cooperative training as a basis for cheap labor have nothing to gain. The student's time is necessarily limited. He must be moved on a progressive course and be given glimpses of many phases of industrial activity in his brief four years of schooling.

If a student should become expert in some phase of his work experience and be kept stationary on one job because of it, it is bound to reflect in the long run to the disadvantage of the student and the cooperating industry.

Schedule Requirements

The kind of work schedule most appropriate for an average student is one which meets the following requirements:

1. Sets up certain specific attainable objectives arranged in progressive order.
2. Takes advantage of the best combination of facilities and personnel available.
3. Takes into account the fact that individual students will be different.
4. Provides work experience during the first and second year in the most basic operations performed in the plant.
5. Provides more specialized experience during the third and fourth years of work upon the particular line for which student is training.
6. Provides during the student's time in the factory a growing acquaintance with plant organization and policies.

These requirements may be further developed as follows:

Requirement No. 1—Sets up certain specific attainable objectives arranged in progressive order. By "certain specific attainable objectives" is meant that it is necessary to select actual jobs in the factory which, when completed, contribute something of a definite nature toward the realization of the student's goal. By "arranged in progressive order" is meant that it is always necessary to choose objectives appropriate to the different stages of the student's development in his factory work experience.

Requirement No. 2—Takes advantage of the best combination of facilities and personnel available. It seems to the author that the job of selecting the best men available to supervise the student is much more important than selecting the actual job which will be assigned to the student in his work schedule. Handling students in such a way that learning takes place whether or not facilities are ideal is essential in any training program. Good supervision even with poor facilities will accomplish far more than good facilities with slipshod supervision.

Requirement No. 3—Takes into account the fact that individual students will be different. All work schedules, to be successful, should allow for individual differences by being sufficiently flexible to serve the needs of the students.

Requirement No. 4 — Provides work experience during the first and second years in the most basic operation in the plant. During the first two years foundation of work experience should be laid for the succeeding years. The best place to

This paper was presented at an Education Session of the Semi-Annual Meeting of The American Society of Mechanical Engineers, at Chicago, June 17, 1947.

TABLE 1—TYPICAL WORK SCHEDULE AND COORDINATION REPORTS PARALLELING THE BASIC ENGINEERING PREPARATION

First Year

Work Schedule	Coordination Reports	Institute Course
	First Semester	
Tool Room 1. Lathe Operator	1. Organization and Layout of the Tool Room	Engineering Math. (Trig. and Anal. Geom.) Industrial Materials (Chemistry)
2. Lathe Operator	2. Lathe Cutting Tools (Feeds and Speeds)	Machine Shop and Shop Methods
3. Lathe Operator	3. Chuck Work on the Lathe	English Composition (Written Reports) Manufacturing Operations Industrial Development
	Second Semester	
4. Surface Grinder 5. Shaper Operator 6. Tool Crib	4. Grinding Wheels 5. Safety in the Tool Room 6. Tool Crib Layout and Functions	Same as first semester except that Physics takes the place of manufacturing operations and industrial development

acquire actual foundation training is in the most basic line of work in the industry. The student in his first two years should learn to work with his hands on jobs that may possibly be dirty and hard. Students cannot hope to get work experience unless they do and are permitted to do actual jobs.

Requirement No. 5 — Provides more specialized experience during the third and fourth years of work upon the particular line for which the student is training.

Specialized Work

That the student should be given more specialized experience during the third and fourth years need hardly be explained. The sequence of Requirement Nos. 4 and 5 is important because it gives the student a sense of promotion in his work experience from the more basic jobs to those with a greater degree of factory importance. Generally speaking, it seems best to assign students at the beginning of the third year to the department in the factory which will probably absorb them upon graduation. Such a plan has much to recommend it:

1. The student has a double incentive to do his best work. He has a desire to make good as a student plus the added desire to make good as an employe in a definite department.

2. The student enjoys the advantage of more than a passing interest from his boss, who would regard him as a probable future employee.

3. It solves the problem of placing graduates. This point cannot be underestimated as it is one that makes cooperative training desirable from a student's standpoint.

4. It insures sufficient specialization to make the student upon graduation a useful employe on a definite job without delay.

Requirement No. 6 — Provides during the student's time in the factory a growing acquaintance with plant organization and policies.

Plant policies and plant organizations can be most thoroughly learned if they are acquired in relation to the reason for their existence. These reasons are to be found everywhere in a factory because they are the workmen, the machines, the buildings, of that factory. The student's own ability to learn these policies from observation can be assisted greatly by his factory supervisors.

As a foundryman, the author will use as an example of a work schedule that of a young student who, on graduation, hopes to carry on his life's work in a foundry.

The cooperative educational program to be described provides for a four year program consisting of alternate periods of academic courses and work periods. A forty-hour week is assumed for the work period with an additional five hours per week devoted to report writing. During the academic portions of the course, students are expected to spend a total of fifty-five hours a week in class and in preparation.

The first two years cover a basic program. In the third and fourth years all of the student's work experience is in the department of his specialization, and the report topics are directly related. During these years about one-third of the time spent in school is on specialized foundry courses.

Table 1 shows the program of a student for the first year of his basic engineering program. Column 1 shows that he was scheduled for a year of experience in the tool room. Column 2 shows the series of reports related to his work experience.

During this first year a student would be assigned to certain basic machines which would help orient him in his new factory life and give him some introductions to production problems.

In the second year (Table 2) this student spent the first half of his time in machine repair and the second half in the drafting room. As before, his report topics parallel his work experience. During the second year the student should be allowed to familiarize himself with the more skilled trades and would be given greater freedom of the factory. Safety is one of the important reasons he would not be allowed to roam too much during his first year.

Interest and Aptitude

By the end of the second year the factory and the student must know what line of work the student is most interested in and best fitted for, and where he might be most valuable to the industry.

Now, bearing in mind that this is a foundry student, let us see what happens to him in his last and most important years. This is the sort of a complete work schedule that should be worked out in advance as a guide to student and to factory instructors. Space prevents giving all four years in this same detail.

This work schedule cannot be used by every organization, but it can serve as a guide for setting up a particular schedule. A group of officials from various General Motors foundries suggested this work schedule in detail from their experiences. This can and should be done by any

industry entering the cooperative education field. The purpose of the work schedule for the third and fourth years is to help the student get experience on line jobs in the foundry and a fundamental knowledge of the mechanics of operation of the foundry so that he is ready at the end of the last two years to carry full responsibility on some significant job in the foundry.

Training Schedule

In order to provide the experience and knowledge referred to in the statement of purpose, the following is proposed as the work schedule:

Third Year—1. Core making. 2. Molding. 3. Melting. 4. Casting cleaning (distributed over six work periods).

Fourth Year—First Semester—1. Maintenance. 2. Trouble shooting. 3. Period allotted for flexibility of assignment.

Second Semester—Assignment to special project to parallel foundry engineering.

Experience is provided in the four main areas of the foundry during the third year. Note the flexibility to permit more time in one or more areas as desired. The first semester of the fourth year gives the student experience in the over-all functioning of the foundry. His second semester parallels his special assignment.

To determine the training the student should receive from his work experience, questions can be considered and answers developed concerning the third year schedule.

What line or staff operations is he on in connection with core making?

1. Sand mixing .... Helper
2. Wire cutter and bending .... Operator
3. Bench cores .... Maker
4. Core blower .... Operator
5. Slinger .... Operator
6. Jolt and roll-over ..... Operator
7. Core baking .... Observer
8. Core dipping .... Operator
9. Core cleaning and patching .... Operator
10. Core assembly .... Operator
11. Core inspection ...... Operator
12. Core scheduling ...... Observer
13. Mixing core dips and pastes .... Helper

Note that wherever possible the student is put on a job as operator or helper. Thus while he is gaining first-hand experience, he is paying his own way. The time spent on each job will vary with the job and the training needs. A day or two on some of the jobs would be sufficient.

Table 2—Typical Work Schedule and Coordination Reports Paralleling the Basic Engineering Preparation

Second Year

Work Schedule	Coordination Reports	Institute Course
	First Semester	
Machine Repair Department	1. Organization of the Machine Repair Department	Engineering Math. (Diff. and Int. Calculus) Physical Metallurgy (Principles and Applications)
(Three work periods on assignments to different jobs)	2. Report on a specific Machine Repair Job	Engineering Drawing and Design
	3. Power Drives (Types and Applications)	Machine Shop and Shop Methods Speech (Oral Reports) Physics
	Second Semester	
Drafting Department		
4. Blueprint Room	4. Print processing Adapted to Specific Uses	Same as first semester except that manufacturing operations and factory organization take the place of physics
5. Filing Room	5. Standard Drafting Practice of the Buick Plant	
6. Junior Detailer	6. Applications of Orthographic Projection	

What line or staff operations is he on in connection with molding?

1. Sand conditioning .... Observer
2. Jobbing floor (molding, pouring, cutting, shakeout) .... Helper
3. Production moldings ... Helper .... and operator
4. Core setting .... Operator
5. Mold sprayer .... Operator
6. Pouring on the jobbing floor or production floor .... Operator

What line or staff operations is he on in connection with melting?

1. Scale man .... Operator
2. Charging crane ...... Observer
3. Lighting up .... Helper
4. Cupola tapper .... Observer
5. Cupola repair and preparation .... Helper
6. Hot metal crane operation .... Observer
7. Slag disposal .... Observer
8. Testing and making ladle additions .... Helper
9. Blast control .... Observer
10. Ladle repair .... Helper
11. Pyrometer reading and recording .... Observer
12. Iron distribution ..... Observer
13. Cupola clerk .... Helper

What line or staff operations is he on in connection with casting cleaning?

1. Knockout .... Operator
2. Shot blast ... Helper or operator
3. Wheelabrator .... Helper or operator
4. Tumbling mill .... Helper
5. Chipping .... Operator
6. Snagging .... Operator
7. Wire pulling .... Operator
8. Water testing .... Operator
9. Grinding or milling locating points .... Helper
10. Inspection .... Operator
11. Salvage .... Operator
12. Heat treat .... Helper
13. Clerk .... Helper

What skill does he get during this one year of his foundry schedule?

1. He should learn to operate under direct supervision:

Muller	Scale car
Paddle-type mixer	Dryer
	Shot blast
Conveyors	Wheelabrator
Molding machines (jolt and squeeze)	Tumbling mill
	Grinder
	Milling machine

2. He should learn to operate under general supervision:

Wire cutter	Core grinders
Core blower	Vibrators
Slinger	Water testing
Jolt roll-over	Brinelling

3. He should learn how to use the following equipment and materials:

Core Cleaning and patching
Cupola repair and preparation
Core dipping and pasting
Testing and making ladle additions

Bench Core	Lighting up
Core assembly	Ladle repair
Core inspection	Chipping
Jobbing molding	Snagging
Core setting	Wire pulling
Mold spraying	Fracture testing
Pouring	Welding

It is the author's thought that the student should get the "feel" of the

different jobs rather than that he become an expert. The extent of skill and foundry knowledge expected during the third year is as follows:

1. Knowledge of foundry terminology.
2. Knowledge of appearance and feel of materials.
3. Knowledge of ingredients and effect of proportions.
4. Appreciation of time, temperature and atmosphere in processing.
5. Appreciation of force, size and shape in the different stages of processing.
6. Appreciation of value of standards and specifications.
7. Appreciation of the value of being able to observe and analyze accurately (patterns of approach used in trouble shooting).
8. Appreciation of value of records (job histories).
9. Appreciation of value of sufficiently accurate measuring and locating devices.
10. Recognition of the economic guides which show where focusing attention will pay off.
11. Appreciation of the importance of each of the many factors that go to produce a quality part (maintenance of equipment, use of equipment, housekeeping, design of equipment).
12. Appreciation of the effect of the quality of an operation or part on the quality of the final foundry product.
13. Appreciation of the importance of balance between all the factors in an operation.

One of the most valuable assets the student can possess by the time he has completed his training and is ready to be assigned to a beginning job is his store of foundry knowledge. These items do not necessarily follow the order of the work experience but rather represent the summation of what he should know after having spent a year in the foundry. The foundry knowledge represents the foundation upon which the specialized courses are built, and the two — specialized courses at the college and the foundry work experience — supplement each other.

The following items summarize what should be expected of the student by way of an understanding of human relations and organizations:

1. Appreciation of importance of coordination between individuals and between operations (organization teamwork).
2. Appreciation of importance of presenting ideas so that others can accept them.
3. Appreciation of the effect of a competitive economy.
4. Appreciation of importance of production scheduling and of meeting schedules.
5. Appreciation of physical effort and working conditions involved in operations.
6. Appreciation of mental effort involved in operations.
7. Appreciation of importance of safety devices and practices.
8. Appreciation of health-protective devices.
9. Appreciation of value of personnel records.
10. Appreciation of importance of individual acceptance of responsibility.
11. Appreciation of the value of making a decision.
12. Appreciation of the value of the knowledge, art and skill that has been developed by experienced men.
13. Appreciation of the progress that has been made.
14. Appreciation of the items that make up costs.
15. Appreciation of the continuous opportunities for improvement of castings, equipment, operations and working conditions.

It should be noted that the work experience can be increased by including work periods in the first two years. Note further that only by following through a well-balanced work schedule can the student begin to obtain the foundry skills, and knowledge, and understanding of human relations and organization.

Advantages of Schedule

The importance of a carefully worked out prearranged work schedule is manifold. First of import is the fact that it acts as a manual for both student and supervisor instructor. For the student, it insures against becoming tied to a single job and guarantees a full picture of his chosen field. For the supervisor instructor, it gives a manual which serves as an easy guide for him in his role of teacher.

It keeps the college instructor continually on his toes as the student will constantly bring back to the school room new methods that he has learned in his work experience at the factory.

The weakest point in cooperative education is the actual trainer on the job, be he workman, foreman, or superintendent. This condition is one that must receive considerable attention from the industry. Certainly, one of the unique features of cooperative education is the fact that the trainer is the principal user of the graduates and stands to gain the most from the successful completion of a well organized work experience schedule.

The finest set-up for a work schedule probably would be to have the school show the student what a screwdriver and a hammer were and then immediately have the boy go over to the factory and use them. Since this is not practical, close coordination of school experience and shop experience is necessary. No better way exists, to the author's knowledge than a carefully arranged work schedule properly carried out.

Magnesium Casting Alloys American vs. European

In a technical report prepared by Staff Sergeant Jay R. Burns, Army Air Forces' Air Technical Service Command, Wright Field, Dayton, Ohio, he relates that American commercial magnesium casting alloys can tolerate microporosity with less loss of mechanical strength than comparable European alloys but are more susceptible to porosity under the same casting conditions.

The basic difference between the American and European alloys is that the foreign alloys contain slightly more aluminum and less zinc than American alloys. This investigation was initiated to compare the alloys relative susceptibility to microporosity and the effect of porosity on mechanical properties.

The report includes numerous tables and graphs showing the relation between mechanical properties and porosity for individual test bars. A radiographic method of scanning castings is described with a photograph of the apparatus.

Bound Volumes Wanted

Requests continue to come in for copies of A.F.A. bound volumes of Transactions, Volumes 48 to 52, inclusive . . . for the years 1940-1944, inclusive.

Any members having copies of the above bound volumes which are not now serving a useful purpose, are urged to notify A.F.A. so that they may be placed in the hands of members who greatly need them. Paper shortages during the war years reduced the number of copies printed, hence our present need for Volumes 48-52.

FOUNDRY PERSONALITIES

A.F.A. Vice-President **W. B. Wallis,** Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa., took off from La Guardia Field July 5 for a three-month European trip, during the course of which he will visit England, Belgium, Sweden, France and Spain. While in Europe, Mr. Wallis intends to contact and resume cordial relations with the several foundry technical associations on the continent and in Britain, many of whose officials attended the 50th Anniversary Convention and Exhibit of A.F.A. in Cleveland, 1946.

R. L. Wilcox, chief engineer, Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., has been elected president, succeeding **D. C. Griggs,** who has become chairman of the board. **J. M. Schaeffer** was named vice-president.

G. A. Custer was recently elected vice-president of Peninsular Grinding Wheel Co., Detroit. Active in the grinding wheel field for 25 years, he has been associated with the Peninsular firm for the last 10 and has served as factory superintendent and as chief engineer. **C. H. Rickenback,** office and personnel manager for five years, has been named assistant secretary.

G. A. Custer

L. E. Everett

L. E. Everett was recently elected vice president of Lester B. Knight & Associates, Chicago, consulting engineers. He was formerly senior engineer.

W. C. Snyder, recently president and general manager of Continental Foundry & Machine Co. and previously with the Lewis Foundry Div., Blaw-Knox Co., in the same capacity, has joined Koppers Co., as a vice-president in the engineering and construction division.

G. D. Pence, recently director of special activities at Willys-Overland Motors, was named president of Wilson Foundry & Machine Co., Pontiac, Mich., effective July 15. He replaces **W. O. Leonard,** resigned. Mr. Pence retired from the army with the rank of major general following the war in which he served in England and North Africa. He was awarded the Distinguished Service Medal and the Legion of Merit, as well as a number of foreign decorations, for his wartime services. A native of Fort Morgan, Ala., he was graduated as a second lieutenant by the United States Military Academy in 1924 and served with the field artillery from that year until 1941, when he was appointed to the General Staff.

C. L. Lane, Cincinnati, for the past two and one-half years works manager of Lunkenheimer Co., joined Schaible Co. on August 1 as vice-president and works manager.

H. C. Minton, who joined Koppers Co., Inc., Pittsburgh, Pa., as production manager in May, has been named a vice-president of the company. Until his recent resignation to join the firm, he was a staff consultant of the Army Ordnance Association, Washington, D. C. During the war, he directed the Army Service Forces production division and held the rank of Brigadier-General.

C. H. Megaw, recently head of the metals division of the War Assets Administration, Philadelphia regional office, has been elected vice president in charge of foundry sales, K. Hettleman & Sons, Inc., Baltimore, Md. Connected with the non-ferrous metals industry for more than 30 years, Mr. Megaw has been associated with Ajax Metal Co. and Acme Metals Refining Corp., both of Philadelphia.

J. J. Mayer, for the last ten years general superintendent, Lumen Bearing Co., Buffalo, N.Y., has been elected vice-president and a director, succeeding the late **C. H. Bierbaum.** He will continue to serve as superintendent.

W. S. McAleer has been elected vice-president, McNally-Pittsburgh Mfg. Corp., Pittsburgh, Kansas. He has been with the firm since 1941, and maintains headquarters at Pittsburgh as eastern district manager.

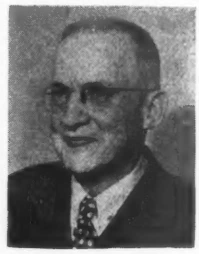
Henry St. Leger has been appointed general secretary of the newly-formed International Organization for Standardization. He is an American, born in Paris and educated in France, England and the United States, and has served recently with the office of the United States Chief Counsel for the axis trials. The national standard bodies of 23 countries are represented in the ISO, including the United States, Brazil, Canada, Chile and Mexico.

G. F. Cronmiller, who has been assistant secretary, was recently named secretary, Harbison-Walker Refractories Co., Pittsburgh, Pa., succeeding **P. R. Hilleman,** retired after 55 years of service. The general traffic manager, **F. M. Ewing,** and advertising manager, **E. B. Guenther,** have retired after, respectively, 47 and 32 years service. They are succeeded by **Theodore Hoover, Jr.,** formerly assistant traffic manager, and **R. R. Miller,** who has been with the export department.

Lieut.-Colonel S. C. Guillan, T.D., has been appointed Secretary of the Institute of Metals (British) and editor of its publications.

L. S. Fletcher, retired from the U. S. Army with the rank of Colonel after 23 years of service, has been appointed technical director of Sam Tour & Co. and its affiliate, American Standards Testing Bureau, both of New York. While with the army, Mr. Fletcher was director of the Rock Island Arsenal laboratory and of the Frankford Arsenal Ordnance laboratory and served four years on the Ordnance Department's ferrous and non-ferrous metallurgical advisory boards. During the war he saw service in both the European and Pacific theaters. He took post-graduate studies in mechanical engineering at M.I.T. and in metallurgical engineering at Watertown Arsenal, and has been active in a number of technical societies.

F. S. Brewster



T. L. Sullivan

F. S. Brewster recently joined Harry W. Dietert Co., Detroit. Formerly foundry metallurgist for Dow Chemical Co. at Bay City, Mich., he has also been associated with General Motors Corp. as chief chemist of the Saginaw (Mich.) Malleable Iron Plant, and with Baker Perkins, Inc., of Saginaw as chief metallurgist. Mr. Brewster served as Secretary-Treasurer of Saginaw Valley A.F.A. chapter for 1946-47, and was previously a director of that group.

Timothy L. Sullivan, foreman at the Pittsburgh, Pa., plant of Federated Metals Div., American Smelting & Refining Co., retired recently after 52 years of service. Fellow employees presented him with a plaque in recognition of his long association. He joined the firm as a scrap sorter at the age of 15, and was made general foreman in 1920.

J. W. Lodge has been named to the staff of Battelle Memorial Institute, Columbus, Ohio, where he will be engaged in research in foundry technology. A graduate of Ohio State University, Columbus, Mr. Lodge was formerly metallurgist, Wheeling Steel Corp.

J. C. Spence, who has been general superintendent at the Pershing Road plant of Link-Belt Co., Chicago, was recently appointed assistant to the vice president and will be located in the executive offices. **E. P. Berg,** recently assistant to the president, has been named general superintendent of the Pershing Road plant. **R. W. Rausch** was appointed chief engineer and **H. W. Regensburger,** divisional engineer in charge of estimate engineering at the plant.

J. M. Weldon, head of the "INCO" sales department aeronautical division, International Nickel Co., New York, since 1945, has been named assistant to the vice-president of the company. He has been associated with the firm since 1927.

R. O. Bullard was recently appointed manager of the metallurgy division of the chemical department, General Electric Co., Schenectady, N. Y. He has been the division engineering and manufacturing manager since last November, and has been associated with the company since 1930. A native of Somerville, N. J., and graduate of Union College, he joined General Electric as a student engineer.

J. L. Griffith was recently appointed New England sales manager, Federated Metals Div., American Smelting & Refining Co., N. Y. Associated with the firm for 17 years, he has been with the division's New York sales office since 1945. He was manager of the company's Cambridge, Mass., plant, 1939-42, and production and sales manager, Lead Products Div., St. Louis, Mo., from 1942 to 1945. In his new capacity, Mr. Griffith succeeds M. L. Levey, resigned.

J. B. Neiman, general manager of aluminum departments of the Federated Metals division, was re-elected president, Aluminum Research Institute, at the recent annual meeting in French Lick, Ind. He has headed the group since early 1941.

F. K. Schroeder has been named purchasing agent for foundry products and supplies, West Allis (Wis.) works, Allis-Chalmers Mfg. Co., and **J. J. Nimtz,** purchasing agent for steel and mill products. **R. C. Allen** has been appointed manager and chief engineer of the engineering development division's new turbo-power department. **W. A. Yost** succeeds Mr. Allen as manager of the steam turbine department.

J. B. Neiman **J. L. Griffith**

E. G. Bailey, vice-president, Babcock & Wilcox Co., New York, was nominated for president of the American Society of Mechanical Engineers in 1947-48 at the semi-annual meeting in Chicago.

Named for two-year terms as vice-presidents are **F. M. Gunby,** Charles T. Main, Inc., Boston; **P. B. Eaton,** head of the mechanical engineering department at Lafayette College, Easton, Pa.; **T. E. Purcell,** general superintendent of power stations, Duquesne Light Co., Pittsburgh, Pa., and **J. C. Brown,** head of the Los Angeles firm bearing his name.

Three have been nominated for terms as directors-at-large: **J. B. Armitage,** vice-president in charge of engineering, Kearney & Trecker Corp., Milwaukee; **A. L. Penniman,** general superintendent, Consolidated Gas, Electric Light & Power Co., Baltimore, and **W. M. Sheehan,** vice-president, General Steel Castings Corp., Eddystone, Pa.

All are unopposed. They will take office at the close of the society's annual meeting December 1-5 in Atlantic City.

W. F. Brennan has returned to Stedman's Foundry & Machine Works, Aurora, Ind., where he was formerly production engineer. He left the firm in 1944 and served two years with the Navy. Recently he has been production supervisor, Franklin Transformer Mfg. Co., St. Cloud, Minn.

Harry Saxter, general superintendent, Aliquippa (Pa.) works, Jones & Laughlin Steel Corp., has retired after more than 47 years in the steel industry. He began his career with American Steel & Wire Co., serving in the blast furnace department, and joined Jones & Laughlin in 1907.

In 1913 Mr. Saxter became assistant superintendent of blast furnaces at Aliquippa; in 1923, superintendent of blast furnace and coke works, with the by-product coke works coming under his direction in 1926. The following year he advanced to assistant general superintendent of the Aliquippa facilities, and in 1930, to his most recent position.

R. R. Raush, Detroit, formerly associated with Ford Motor Co. and one-time general superintendent of Timken Detroit Axle Co., has been retained as consultant on manufacturing matters by General Electric Co., New York. He will serve on the president's staff.

A recent visitor at the National Office was **Robert Doat,** foundry engineer of Compagnie Generale des Conduites d'eau, Liege, Belgium, who is in this country visiting pipe foundries for information on modern American methods. Mr. Doat's company, itself 85 years old, is located on the site of a blast furnace erected over 400 years ago, from which was cast pipe for the famous fountain in Versailles Gardens at Paris over three centuries ago.

W. C. Adler **H. W. Creeger**

H. W. Creeger has been appointed field engineer for Electro Refractories & Alloys Corp. with headquarters in Houston, Texas. Prior to war service as Captain, Army Air Force, engineering division, he represented the firm in Los Angeles.

W. C. Adler, recently with Ohio Steel Foundry Co., Lima, Ohio, where he was in charge of sand for the past six years, has joined Eastern Clay Products, Inc., Jackson, Ohio, as a service engineer. He will be principally concerned with applications of chemically-coated sands. Mr. Adler is a member and a past director of Toledo A.F.A. chapter.

J. G. Eberhardt, recently foundry superintendent for Central Specialty Co., Ypsilanti, Mich., has joined the sales staff of Hougland & Hardy, Inc., and Hardy Sand Co., Evansville, Ind.

L. S. Taylor, chief of the x-ray section of the National Bureau of Standards, Washington, D.C., has been elected an associate fellow in the American College of Radiology. He is the author of "Physical Foundations of Radiology," used as a text book by some universities, and has been associate editor of the *American Journal of Roentgenology* since 1930 and atomic physics editor of *Radiology* since 1931. During the war he took an active part in the development of the radio proximity fuse, and later served with the operational research section of the Ninth Air Force as head of a group of civilian scientists.

R. G. Standerwick, engineer with the Lynn, Mass., Aircraft Turbine Div., General Electric Co., has retired after 38 years of service. He was in charge of the group that developed the first I-16 jet engine.

R. A. Quadt, research metallurgist, Federated Metals Div., American Smelting & Refining Co., recently reviewed his 1947 A.F.A. Convention paper, "Effect of Room

(Concluded on page 78)

CHINESE FOUNDRYMEN SEND COOKING POT TO ASSOCIATION

FOR CENTURIES the Chinese have cast and used iron cooking pots of remarkable thinness. Recently the Chinese Foundrymen's Association, formed last year, made a gift of one of these pots to the American Foundrymen's Association.

While visiting in the United States last year, Ping Kao Han, secretary of the Chinese Foundrymen's Association, discussed thin and permanent mold castings with various foundrymen. After talking to P. E. Rentschler, president, Hamilton Foundry & Machine Co., Hamilton, Ohio, which makes some castings about 1/10-in. in thickness, Mr. Han decided to show what Chinese foundrymen can do. On his return to Shanghai, he sent two Chinese cooking pots, one for Mr. Rentschler and another for A.F.A.

The pot illustrated is 11½ in. in diameter and 3 in. deep. Thickness ranges from a feather edge to approximately 1/32-in., with the bottom slightly heavier.

Utensils Cast Upside Down

Chinese cooking pots are cast upside down in a semi-permanent mold made in two sections. These sections are composed of clay, sand and some local material. The pot is direct gated at the bottom and the gate is removed with an iron knife immediately after pouring. No riser is needed. From the assembly of a mold to the end of the cycle is about two minutes, about 60 pots being produced in eight hours. The life of a mold is 200 to 500 pots.

For work of this kind, iron is melted in the cupola with charcoal as a fuel, rather than coke, to eliminate sulphur pickup. A typical analysis for one of these cooking pots is: total carbon 3.20%; silicon 2.06%; manganese 0.45%; sulphur 0.126%; phosphorus 0.55%.

The pots, which are very popular and widely used in China, range from six inches in diameter and four inches deep to five feet in diameter and three feet in depth. The size required depends on the size of the family.

Cooking pot sent to the American Foundrymen's Association by Ping Kao Han, secretary, Chinese Foundrymen's Association.

Book Reviews

Manual of Foundry and Pattern Shop Practice, by Otis J. Benedict, Jr. 361 pages. Price $3.25. McGraw-Hill Book Company, New York. 1947.

This book is a text on elementary cast iron foundry practice. Presumably written for engineering school use, the book falls far short of the type of text needed for teaching modern foundry practice to engineering students. *Manual of Foundry and Pattern Shop Practice* could not be used in teaching the college foundry course described on page 59 of the July issue of AMERICAN FOUNDRYMAN. However, it will be useful in training gray iron foundry apprentices and in trade and technical high schools.

Written in two sections, the first part of the book deals almost exclusively with gray iron foundry practice. There is very little information on non-ferrous casting alloys, the subject being covered in 7 pages with nothing on magnesium alloys. There is only incidental mention of malleable and steel practice.

It is most disappointing to find that many important phases of modern foundry practice are not developed, and in some cases, not even mentioned. Some that have been neglected are: casting design, mechanization, foundry layout, production methods, inspection and heat treatment of castings.

The book contains not a single photomicrograph nor a constitution diagram.

The second section of the book is devoted to materials, tools and procedures for patternmaking. This section is unlikely to find much use in engineering colleges because patternmaking is taught on a drawing board in this type of school, if it is taught at all. However, the patternmaking section, which includes a chapter on 25 patternmaking projects, will be useful to a trade school or technical high school.

Visual aids, which are becoming more and more important in modern education, are included in the last section of the book. The films and film strips listed will be helpful to schools and shops to which the facilities of a visual training department are not available.

Practical Emulsions, by H. Bennett. 568 pages. Price $8.50. Chemical Publishing Co., Inc., Brooklyn. 1947.

In making cores, which should be added to the sand first—the oil or the water? Do wetting agents increase the efficiency of a binder or make it easier to mix with the sand? *Practical Emulsions* does not answer these questions, but someday some foundry worker may find the answer through application of information contained in this book.

While no specific references are made to foundry practice, foundrymen who are interested in experimenting can probably use this book as a background for preparing: core binders, liquid partings, graphite lubricants and protective hand creams. Burn emulsions and coolants are also covered.

A practical rather than a theoretical treatment is given the subject of emulsions in this book.

★ NEW A. F. A. MEMBERS ★

June 15 to July 15 — The rapid growth of the British Columbia and Central Michigan chapters continues to set the pace on this month's new membership page. Our third Canadian chapter displays 24 names below, 3 being company members and Michigan's fourth annex, records 16 new foundrymen, including 5 company memberships. Northeastern Ohio sent 13 new enrollees to add to its list of over 500 members.

BIRMINGHAM DISTRICT CHAPTER

J. L. Builder, Purch. Agent, Rudisill Foundry Co., Anniston, Ala.

BRITISH COLUMBIA CHAPTER

*Associated Foundry Ltd., Vancouver, B.C., Canada (Howard A. Sturrock, Man. Dir.)
*Nairn Bros. Foundry, Vancouver, B.C., Canada (David Nairn, Partner)
*Terminal City Iron Works Ltd., Vancouver, B.C., Canada (Oscar R. Olson, Gen. Mgr.)
Orton Asleson, Supt. of White Metals Dept., Great Western Smelting Co., Vancouver, B.C., Canada.
Harry Brayfield, Molder, Associated Foundry Ltd., Vancouver, B.C., Canada.
Kenneth Brown, Molder, Associated Foundry Ltd., Vancouver, B.C., Canada.
John Douglas, Molder, Associated Foundry Ltd., Vancouver, B.C., Canada.
A. M. Duncan, Secretary, Associated Foundry Ltd., Vancouver, B.C., Canada.
Reginald D. Foulds, Slsmn., Great Western Smelting Co., Vancouver, B.C., Canada.
Geoffrey E. Fox, Sls. & Prod., Associated Foundry Ltd., Vancouver, B.C., Canada.
Mark Hannah, Molder, Associated Foundry Ltd., Vancouver, B.C., Canada.
George W. Hunt, Frm., Nairn Bros. Foundry, Vancouver, B.C., Canada.
Garnet E. A. Innes, Patt. Shop Frm., Terminal City Iron Works Ltd., Vancouver, B.C.
Robert S. McQuillan, Mgr., Great Western Smelting Co., Vancouver, B.C., Canada.
Fred Nye, Owner, Nye Foundry, Vancouver, B.C., Canada.
Alex Paterson, Iron Fdry. Frm., Terminal City Iron Works Ltd., Vancouver, B.C., Canada.
John W. Pudney, Frm., Wm. McPhail & Son, Vancouver, B.C., Canada.
John D. Runkle, Prod. Supv., British Columbia Tube Works Ltd., Burnaby, B.C., Canada.
Thomas Sinclair, Molder, Associated Foundry Ltd., Vancouver, B.C., Canada.
Donald B. Sturrock, Molder, Associated Foundry Ltd., Vancouver, B.C., Canada.
J. C. Sturrock, Asst. Supt., Associated Foundry Ltd., Vancouver, B.C., Canada.
Alfred Tracey, Molder, Associated Foundry Ltd., Vancouver, B.C., Canada.
William Purdy, Supt. of Bronze Ingot Dept., Great Western Smelting Co., Vancouver, B.C., Canada.
C. B. Wilson, Supt., Associated Foundry Ltd., Vancouver, B.C., Canada.

CANTON DISTRICT CHAPTER

*Mansfield Sanitary Pottery, Inc., Perrysville, Ohio (Warren J. Drouhard).
Louis E. Holm, Met. Engr., Kerchner, Marshall & Co., Pittsburgh, Pa.
Coolidge A. Karns, Res. Met., United Engineering & Foundry Co., Canton, Ohio.

CENTRAL ILLINOIS CHAPTER

*American Foundry & Furnace Co., Bloomington (Clinton B. Soper, Treas.).
Richard Burgard, Appr., Caterpillar Tractor Co., Peoria.
Floyd G. Matthews, Appr., Caterpillar Tractor Co., Peoria.

CENTRAL INDIANA CHAPTER

N. H. Harris, Mgr., Liberty Engineering Div., Kirk & Blum Mfg. Co., Indianapolis.
Harold N. Myers, Proj. Engr., Perfect Circle Corp., Hagerstown.
Earl L. Stevens, Sls. Engr., National Foundry Sand Co., Detroit.

CENTRAL MICHIGAN CHAPTER

*Calhoun Foundry Co., Inc., Homer (John R. Granger, Pres.).
*Consolidated Press Div., E. W. Bliss Co., Hastings, (Robert Shannon, Fact. Supt.).
*Riverside Foundry & Galvanizing Co., Kalamazoo, (Palmer B. Coombs, Gen. Mgr.).
Dan Allerding, Frm.(C/R), Consolidated Press Div., E. W. Bliss Co., Hastings.
Leonard Calicotte, Night Supt. of Finish., Albion Malleable Iron Co., Albion.
Lou Dobson, Albion Malleable Iron Co., Albion.
Clare Johnson, Frm. (Side Floor), Consolidated Press Div., E. W. Bliss Co., Hastings.
John Martin, Frm. (Main Floor), Consolidated Press Div., E. W. Bliss Co., Hastings.
Stephen Pasick, Plt. Supt., Albion Malleable Iron Co., Albion.
George Petredean, Treas., Calhoun Foundry Co., Inc., Homer.
Charles Rowley, Supt. Fdry., Consolidated Press Div., E. W. Bliss Co., Hastings.
George F. Schanz, Vice-Pres., Calhoun Foundry Co., Inc., Homer.
Dick Sifford, Sls. Repr., Parker Halversen Co., Niles.
Lynn Snyder, Frm. (Cupola), Consolidated Press Div., E. W. Bliss Co., Hastings.
Joe C. Warrick, Sec'y., Calhoun Foundry Co., Homer.
Emil Zeuch, Purchasing, John Bean Mfg. Co., Lansing.

CENTRAL OHIO CHAPTER

Wm. C. Adler, Service Engr., Eastern Clay Products, Inc., Jackson.
H. O. McIntire, Res. Engr., Battelle Memorial Institute, Columbus

* Company Membership

CHESAPEAKE CHAPTER

Burton W. Graham, Sls. Mgr., The Davison Chemical Corp., Baltimore, Md.

CHICAGO CHAPTER

*Fabreeka Products Co., Chicago. (Allen E. Bardwell, Western Div. Mgr.)
Leonard Chlebek, Appr., Mfg. Brass Fdry., Chicago.
C. F. Christopher, Continental Foundry & Machine Co., East Chicago, Ind.
Robert L. Hannan, Dist. Repr., Beardsley & Piper Co., Chicago.
Red Morgan, Frm., United Boiler, Heating & Foundry Co., Hammond, Ind.
Wm. M. Mugan, Appr., Howard Foundry, Chicago.
Harry J. Piecul, Appr., Riverside Iron Works, Chicago.
Leo Prushinski, Appr., Sheffield Foundry Co., Chicago.
William C. Shirley, Chf. Met., U. S. Reduction Co., East Chicago, Ind.
Casimir Sysko, Appr., Noonan-Malmstrom Co., Chicago.
Joseph James Vrba, Appr., Greenlee Foundry Co., Chicago.
Harry P. Wolski, Appr., Hansell Elcock Co., Chicago.

DETROIT CHAPTER

*Central Specialty Div., King-Seeley Corp., Ypsilanti, Mich. (C. T. Watling, Off. Mgr.)
George J. Cadey, Partner, Cadey Aluminum Foundry Co., Grand Rapids, Mich.
George A. Fuller, Jr., Br. Mgr., Federal Foundry Supply Co., Detroit.
Tony P. Galan, Asst. Gen. Frm., Pontiac Motor Car Div., General Motors Corp., Pontiac, Mich.
Frank Goda, Frm. Sand Control, Pontiac Motor Car Div., General Motors Corp., Pontiac, Mich.
Clifford O'Rielly, Chf. Engr., Electric Welding & Machines, Detroit.
Julian N. Phelps, Fdry. Met., Vanadium Corp. of America, Detroit.

E. CANADA & NEWFOUNDLAND CHAPTER

Howard E. Edsall, Gen. Supt., Sorel Steel Foundries Ltd., Sorel, Quebec.

METROPOLITAN CHAPTER

D. Cameron Bradley, Market Devel. Div., The New Jersey Zinc Co., New York.
George H. Craig, Sls. Repr., Barth Smelting Corp., Newark, N.J.
M. R. Niman, Vice-Pres., National Foundry Co. of New York, Inc., Brooklyn, N.Y.
Ely Portman, Fdry. Met., Nassau Smelting & Refining Co., Tottenville, Staten Island, N.Y.
Daniel H. Wenny, Jr., Met., Bell Telephone Labs. Inc., Murray Hill, N.J.

NORTHEASTERN OHIO CHAPTER

William M. Angus, Trainee, National Malleable & Steel Castings Co., Cleveland.
Robert V. Bergstrom, Abra. Engr., Norton Co., Cleveland.
William Neal Brammer, Methods Engr., Thompson Aircraft Products Co., Cleveland.
William J. Bueche, Fdry. Cons., Frank L. Crobaugh Co., Cleveland.
Harrold L. Gobeille, Jr., Appr., Crucible Steel Castings Co., Cleveland.
Robert H. Hafner, Jr., Met., Humphryes Mfg. Co., Mansfield.
E. L. Kremer, Gen. Mgr., Lake City Malleable, Inc., Ashtabula.
Harold G. Mabry, Master Mech., National Malleable & Steel Castings Co., Cleveland.
James McGuire, Meltg. Frm., National Malleable & Steel Castings Co., Cleveland.
Waldemar Meckes, Jr., Advertising Mgr., Werner G. Smith Co., Cleveland.
Walter Quayle, Div. Supt., National Malleable & Steel Castings Co., Cleveland.
Alan H. Richardson, Plt. Engr., Lake City Malleable, Inc., Ashtabula.
Albert N. Thorrat, Sand Tech., Werner G. Smith Co., Cleveland.

NORTHERN CALIFORNIA CHAPTER

Elmer Nagy, Sls., Marwood Limited, San Francisco.
Francis M. Shaw, Sls. Repr. Calif., Eriez Manufacturing Co., San Francisco.

NORTHWESTERN PENNSYLVANIA CHAPTER

*Pittsburgh Metals Purifying Corp., Pittsburgh. (Peter Soffel, Pres.)
Carl Duryee, Acting Frm. Fdry., The Electric Materials Co., North East.

ONTARIO CHAPTER

Donald Eby, Supt., Philip Gies Foundry, Ltd., Kitchener.
F. G. Loeffler, Vice-Pres.-Sec'y., Bryant Pattern & Mfg. Co. Ltd., Windsor.
James McConachie, Sand Control, Wm. Kennedy & Sons Ltd., Owen Sound.
J. Albert McMeekin, Asst. Fdry. Supt., Wm. Kennedy & Sons Ltd., Owen Sound.

OREGON CHAPTER

Wm. M. Halverson, Insp., Electric Steel Foundry Co., Portland.

PHILADELPHIA CHAPTER

Charles Brochini, Met., Lehigh Foundries Inc., Easton, Pa.
Albert E. Hartman, Stanley G. Flagg & Co., Stowe, Montgomery Co., Pa.
John P. Hoot, Secretary, Carson, Marshall & Co., Inc., Philadelphia.
George W. Peterson, Vice-Pres., James S. Kemper & Co., Philadelphia.

QUAD CITY CHAPTER

Joseph A. Avdek, Asst. Plt. Engr., Riverside Foundry, S. & W. Corp., Bettendorf, Iowa.
Richard L. Cain, Chf. Insp., Riverside Foundry, S. & W. Corp., Bettendorf, Iowa.
Ira Chandler, Asst. Frm., Deere & Mansur Works, Moline, Ill.
William E. Driscoll, Fdry. Engr., Waterloo Foundry Co., Waterloo, Iowa.
Emery Havner, Fdry. Supt., Six's Foundry, Fairfield, Iowa.
William B. Heintz, Frm., Riverside Foundry, S. & W. Corp., Bettendorf, Iowa.
J. C. McCartney, Chf. Insp., Union Malleable Iron Works, Deere & Co., East Moline, Ill.
William. O. McFatridge, Asst. Supt. Fdry., Farmall Works, International Harvester Co., Rock Island, Ill.
Russell A. Schmidt, Plt. Met., John Deere Plow Works, Moline, Ill.

ROCHESTER CHAPTER

G. M. Etherington, Met., Gleason Works, Rochester, N.Y.
James Ferguson, Frm., Gleason Works, Rochester, N.Y.

SAGINAW VALLEY CHAPTER

Gilbert R. Burr, Prod. Supt., Chevrolet Grey Iron Foundry, Saginaw, Mich.

ST. LOUIS DISTRICT CHAPTER

Thomas B. Hall, Slsmn., Laclede-Christy Clay Products Co., St. Louis.
Frank L. Skerritt, Plt. Supt., The Atchison Spec. Mfg. Co., Atchison, Kan.
O. C. Wheeler, Slsmn., U. S. Reduction Co, East Chicago, Ind

SOUTHERN CALIFORNIA CHAPTER

*Fairbanks, Morse, & Co., Pomona. (Ray Silva, Fdry. Supt.)
Walter Russell Lindersmith, Sls., Balfour-Guthrie & Co., Ltd., Los Angeles.
Jerry L. Seals, Pattmkr., Modern Pattern Works, Waukegan, Ill. (Appr.)

TEXAS CHAPTER

Henry W. Creeger, Jr., Field Engr., Electro Refractories & Alloys Corp., Buffalo, N.Y.
Marvin W. Williams, Fdry. Mgr., Hughes Tool Co., Houston.

TIMBERLINE CHAPTER

E. W. Miner, Pres., H. & M. Machine Shop, Denver.
Philip Paden, Pres., Compressed Steel Co., Inc., Denver.

TRI-STATE CHAPTER

Ralph C. Brown, Owner, Brown Pattern Works, Tulsa, Okla.

WASHINGTON CHAPTER

Harold F. Warren, Sls. Engr., R. E. Chase & Co., Tacoma.

* Company Membership

WESTERN MICHIGAN CHAPTER

James T. Dailey Sr., Supt. Maint., National Motor Castings Div., Campbell, Wyant & Cannon Foundry Co., South Haven.

WESTERN NEW YORK CHAPTER

Raymond H. Buckley, Supt., Carley Heater Co., Inc., Olean.

WISCONSIN CHAPTER

Peter Berntsen, Partner, Berntsen Brass & Aluminum Foundry, Madison.
Kenneth G. McCauley, Stand. Dept., Four Wheel Drive Auto Co., Clintonville.
Fred C. Mueller, Trainee, Zenith Foundry Co., West Allis.
Norman Paulson, Grede Foundries, Inc., Milwaukee.
Herbert H. Ruchel, Supt. of Fdries., Ampco Metal Inc., Milwaukee.
Herbert G. Sommer, Supt., Kohler Co., Kohler.
John A. Ziebell, St. & Appr., Universal Foundry Co., Oshkosh.

OUTSIDE OF CHAPTER

Fred B. Clarke, New England Mgr., Whitehead Brothers Co., Providence, R.I.
Howard F. Donald, Chemist., Draper Corporation, Inc., Hopedale, Mass.
Roy E. Hayward, Fdry. Plan. Engr., Draper Corporation, Inc., Hopedale, Mass.
Ralph H. Gower, Chemist, General Electric Co., West Lynn, Mass.
William H. Henson, Mgr. Sls. Engr., Refrac. Div., Norton Co., Worcester, Mass.
Manning, Maxwell & Moore, Inc., Watertown, Mass.
William D. Merrilees, Asst. Supt., Draper Corporation, Inc., Framingham, Mass.
James P. Robinson, Trainee, United Shoe Machinery Corp., Beverly, Mass.

ENGLAND

Dr. Slater, Central Met. Laboratory, Emsworth House, Emsworth, Hants.

FRANCE

Acieries de Gennevilliers, Gennevilliers, Paris.
Rene Baumes, Fdry. Mgr., Berliet Co., Venissieux, Rhone.
J. B. Renard, Wks. Mgr., Japy Freres, Paris.
Societe des Hauts-Forneaux of Saulnes, Jean Raty & Cie, Paris.

ITALY

Vittorino Dettin, Mech. Engr., Odero-Terni-Orlando, Genoa.

SOUTH AFRICA

The Gen. Wks. Mgr., Vanderbilj Engineering Corp. Ltd, Vanderbilj Park, Transvaal.
Richard Knox Tait, Met. Asst., The Union Steel Corp. of S. A. Ltd., Vereeniging.

SWEDEN

Ake Johnson, Pres., AB Johnson Metall, Orebro.

FUTURE CONVENTIONS AND EXHIBITS

National Association of Power Engineers, Inc., Boston, Mass.—Aug. 25-29.

American Institute of Electrical Engineers, Bi-Monthly Meeting, San Diego, Calif.—Aug. 26-29.

American Society of Mechanical Engineers, Fall Meeting, Salt Lake City, Utah—Sept. 1-4.

Instrument Society of America, Second National Conference, Stevens Hotel, Chicago—Sept. 8-12.

American Chemical Society, 112th Meeting, New York—Sept. 15-19.

National Machine Tool Builders' Association, Machine Tool Show, Chicago—Sept. 17-26.

National Petroleum Association, 45th Annual Meeting, Hotel Traymore, Atlantic City, N.J.—Sept. 17-19.

Association of Iron & Steel Engineers, Fall Meeting, Pittsburgh, Pa.—Sept. 22-25.

American Institute of Electrical Engineers, Middle Eastern District Meeting, Dayton, Ohio—Sept. 23-25.

American Institute of Chemical Engineers, Regional Conference, Buffalo, N.Y.—Sept. 29-Oct. 1.

American Gas Association, San Francisco—Sept. 29-Oct. 3.

Gray Iron Founders' Society, 19th Annual Convention, Hotel Schroeder, Milwaukee—Oct. 2-3.

National Safety Council, 36th Annual National Safety Congress & Exposition, Hotel Stevens, Chicago—Oct. 6-10.

National Metal Exposition, International Amphitheatre, Chicago—Oct. 18-24.

American Welding Society, National Metal Congress & Exposition, Sherman Hotel, Chicago—Oct. 20-24.

American Institute of Mechanical Engineers, Fall Meeting, Iron & Steel Div., & Institute of Metals Div., Stevens Hotel, Chicago—Oct. 20-22.

American Welding Society, Annual Meeting, Chicago—Oct. 20-24.

American Society for Metals, Palmer House, Chicago—Oct. 20-24.

American Industrial Radium & X-Ray Society, Continental Hotel, Chicago—Oct. 20-24.

Pacific Chemical Exposition, San Francisco, Calif.—Oct. 21-28.

National Electrical Manufacturers Association, Atlantic City, N.J.—Oct. 27-31.

The Magnesium Association, 4th Annual Meeting, Pennsylvania Hotel, New York—Oct. 30-31.

American Society for Tool Engineers, 15th Semi-Annual Meeting, Statler Hotel, Boston—Oct. 30-Nov. 1.

American Institute of Mechanical Engineers, Annual Fall Meeting, Deshler-Wallick Hotel, Columbus, Ohio—Oct. 31-Nov. 1.

Regional Foundry Conference, Michigan State College, East Lansing, Mich.—Oct. 31-Nov. 1.

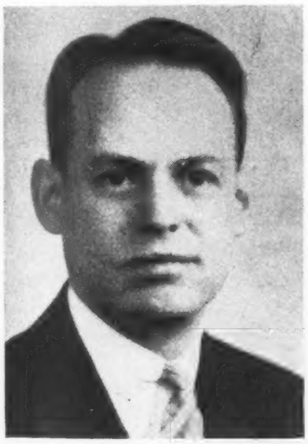
CHAPTER OFFICERS

L. C. Gleason
Gleason Works
Rochester, N.Y.
President
Rochester Chapter

H. E. Craddock
Beatty Bros. Ltd.
London, Ont.
Director
Ontario Chapter

C. K. Faunt
Christensen & Olsen Foundry Co.
Chicago
Vice President
Chicago Chapter

F. C. Cech
Cleveland Trade School
Cleveland
Director
Northeastern Ohio Chapter



F. W. Fuller
National Engineering Co.
Columbus
Vice Chairman
Central Ohio Chapter

R. H. Swartz
S & W Foundry Corp.
Bettendorf, Iowa
Chairman
Quad City Chapter

H. B. Voorhees
Peru Foundry
Peru, Indiana
Chairman
Michiana Chapter

J. F. Livingston
Crouse-Hinds Company
Syracuse, N.Y.
Secretary
Central New York Chapter

J. W. Clarke
General Electric Co.
Erie, Pa.
Chairman
Northwestern Pennsylvania Chapter

L. H. Horneyer
Lee H. Horneyer Co.
St. Louis, Mo.
Director
St. Louis District Chapter

K. A. DeLonge
International Nickel Co.
New York
Chairman
Metropolitan Chapter

O. E. Sundstedt
General Foundry & Mfg. Co.
Flint, Mich.
Chairman
Saginaw Valley Chapter

★ CHAPTER ACTIVITIES ★

news

Northern Illinois-Southern Wisconsin

AT THE ANNUAL business meeting, Northern Illinois and Southern Wisconsin chapter named J. T. Clausen, Greenlee Bros. & Co., Rockford, Ill., *Chairman* for 1947-48. He was Vice-Chairman the past season.

H. J. Bauman, Ebaloy, Inc., Rockford, Secretary for 1946-47, is the new *Vice-Chairman.*

L. C. Fill, George D. Roper Corp., Rockford, formerly Treasurer, was named *Secretary,* and J. N. Johnson, J. I. Case Co., of the same city, who has served as a Director, was chosen as *Treasurer.*

Directors elected include Oscar Josephson, S. Obermayer & Co., Rockford; Jack Rundquist, Beloit (Wis.) Foundry Co.; Bruce Whiting, Woodmanse Mfg. Co., Freeport, Ill.

Mexico City

ING. MANUEL GOICOCHEA, Fundiciones de Hierro y Acero, S.A., will head the Mexico City chapter as *President* for 1947-48. He served as Vice-President for the past season.

E. M. Sauza, Fundiciones y Talleres America, who has been a director, is the new *Vice-Chairman.*

N. S. Covacevich, Casa Covacevich Foundry Supplies & Equipment, has been reelected *Secretary* and Ing. F. G. Vargas, metallurgist and foundry consultant, *Treasurer.*

Directors named include Ing. Secundio Ruiz, Hiero Maleable de Mexico, S.A., and D. E. Stine, La Consolidada, S.A.

Elections took place at the annual business meeting June 6.

Central Michigan

THE STEERING COMMITTEE of Central Michigan chapter met June 12 at the Schuler Hotel, Marshall, and

A few of the many Old Timers the Northeastern Ohio chapter had as guests at their May 8 meeting in Cleveland.

(Photos courtesy Sterling N. Farmer, Sand Products Corp., Cleveland)

(Photo courtesy John Bing, A. P. Green Fire Brick Co.)

Norman Salo (left), Carl Young and George Baier, Koehring Foundry Div., Koehring Co., Milwaukee, winners of the three prizes in the local gray iron molding contest sponsored by the A.F.A. Wisconsin chapter. Mr. Salo won third honors and Messrs. Young and Baier, first and second, respectively. All are former servicemen and have completed about one and one half years of their indentures.

named officers and directors to serve until the first regular elections, to be held in the fall.

D. J. Strong, Foundry Materials Co., Coldwater, continues as *Chairman* and Fitz Coghlin, Jr., Albion Malleable Iron Co., Albion, is *Secretary-Treasurer.*

C. C. Sigerfoos, Michigan State College, East Lansing, was named *Vice-Chairman.*

Directors, to serve for three years, are Erwin Doerschler, U. S. Foundry Co., Kalamazoo; Jack Durr, Albion Malleable Iron Co.; E. H. Schlepp, Riverside Foundry & Galvanizing Co., Kalamazoo.

Chosen for two-year terms as *Directors* are O. J. Drumm, Battle Creek Bread Wrapping Machine Co., Battle Creek; A. E. Rhoads, Casting Engineering, Inc., Marshall; J. E. Wolf, Midwest Foundry Co., Coldwater.

C. W. Dock, Dock Foundry Co., Three Rivers; Charles Fike, Hardie Mfg. Co., Hudson, and Harry McCool, American Marsh Pumps, Inc., Battle Creek, named *Directors* for one year.

At the regular chapter meeting June 24, R. L. Orth, American Wheelabrator & Equipment Corp., Detroit, was technical speaker on "Abrasive Blasting." He gave the foundrymen practical information on applications, techniques and equipment, illustrated his remarks with numerous photographs and diagrams, and discussed both air and mechanical blasting techniques and installations. In concluding, Mr. Orth presented recommenda- and shape of metal abrasives. (See pp. 22-25, this isue).

Timberline

C. E. Stull
Manufacturers Foundry Corp.
Chapter Secretary

THE FORMER "Rocky Mountain

Toledo area foundrymen who took part in the chapter's annual picnic held at Irish Hills, June 14.

(Photos courtesy Sterling N. Farmer; Sand Products Corp., Cleveland)

The Michiana chapter may have its champion bait caster and the Chicago chapter its champion golfer but the Southern California chapter is the producer of bowling champs. Above are shown the 1947 champions representing Foundry Specialties Co., Los Angeles. Team members standing are (left to right) A. Greeley, R. Rozelle, A. Colp and A. Warren (D. Johnston, not in picture). Kneeling in front chapter past president Walter Haggman (right) sponsor of the team accepts the A.F.A. Trophy from Harold Bierley, Production Pattern & Mfg. Co., Los Angeles, chairman entertainment committee.

Empire" chapter changed its name to "Timberline" chapter by unanimous vote of the members at the annual business meeting.

J. L. Higson, Western Foundry, Denver, was named to continue as *Chairman* for the coming season.

S. C. Cooke, U. S. Foundries, Inc., Denver, was elected *Vice-Chairman* for 1947-48.

C. E. Stull, Manufacturers Foundry Corp., and J. W. Horner, Slack-Horner Brass Mfg. Co., both of Denver, were reelected *Secretary* and *Treasurer*, respectively.

Directors, to serve for three years, are P. M. Payne, Rotary Steel Casting Co.; C. O. Penney, C. S. Card Iron Works Co.; E. B. McPherson, McPherson Corp., and E. B. Zabriskie, Magnus Metal Div., National Lead Co., all of Denver.

Texas

W. H. Lyne
Hughes Tool Co.
Chapter Reporter

ELECTION of officers and directors of Texas chapter was held at the annual business meeting June 20 in the Golfcrest Country Club, Houston.

M. W. Williams, Hughes Tool Co., Houston, was the choice of the members as *Chairman* for 1947-48, and Jake Dee, Dee Brass Foundry, Houston, as *Vice-Chairman.*

H. L. Wren, manufacturers representative, Houston, was reelected *Secretary-Treasurer.*

Directors named to serve for three years are C. R. McGrail, Texaloy Foundry, San Antonio; H. L. Roberts, Oil City Iron Works, Corsicana; C. W. Williamson, Trinity Valley Iron & Steel Co., Fort Worth; Joe Wolf, Wolf Pattern Works, Houston.

At the business session Chapter Chairman W. M. Ferguson, Texas Electric Steel Casting Co., Houston, displayed a memorial plaque prepared by the chapter for presentation to the family of the late L. H. August, who was Chapter Vice-Chairman at the time of his death. The members voted to prepare a

AUGUST-SEPTEMBER CHAPTER MEETINGS

AUGUST 16

CENTRAL MICHIGAN
Waterworks Park, Coldwater, Mich.
OUTING

ROCHESTER
Elser's Grove
SUMMER OUTING

AUGUST 23

NORTHWESTERN PENNSYLVANIA
Ranchero, West of Erie
OUTING

ONTARIO
Ralph Barnes Estate, Barnesdale
OUTING

CANTON DISTRICT
Otis Clay Farm
ANNUAL PICNIC

SEPTEMBER 1

CHICAGO
Chicago Bar Association

SEPTEMBER 6

WESTERN MICHIGAN
Spring Lake Country Club
SEVENTH ANNUAL PICNIC

SEPTEMBER 8

CINCINNATI DISTRICT
Engineering Society Headquarters
FORUM

SEPTEMBER 11
NORTHEASTERN OHIO
Cleveland Club
G. Vennerholm
Ford Motor Company
Casting Methods in Automotive Manufacturing

SEPTEMBER 20
BIRMINGHAM DISTRICT
Roebuck Country Club
ANNUAL PICNIC

SEPTEMBER 21
CENTRAL INDIANA
ANNUAL OUTING

SEPTEMBER 26
CHESAPEAKE
Engineers Club
Baltimore, Md.

(*Photos courtesy John Bing, A. P. Green Fire Brick Co.*)

Annual Old Timers party of the Wisconsin chapter was held May 9 with a total attendance of 450. Shown are some Wisconsin foundrymen honored at this banquet.

similar plaque for the family of C. W. Trout, the late president of Lufkin Foundry & Machine Co.

Birmingham District

J. P. McClendon
Stockham Pipe Fittings Co.
Chapter Reporter

OFFICERS AND DIRECTORS of Birmingham District chapter were guests of Chairman W. E. Jones, Stockham Pipe Fittings Co., Birmingham, June 27 at a luncheon in his firm's cafeteria.

Following the luncheon there was a business session, at which committee chairmen were elected. Dr. J. T. MacKenzie, American Cast Iron Pipe Co., Chapter Vice-Chairman, was named to head the program committee; D. C. Abbott, Hill & Griffith Co., the membership group; D. C. McMahen, Harbison-Walker Refractories Co., entertainment, and J. P. McClendon, Stockham Pipe Fittings Co., publicity. All are of Birmingham.

The group voted unanimously to hold the chapter's annual picnic in September, the entertainment committee to select the date and place.

Central Illinois

G. H. Rockwell
Caterpillar Tractor Co.
Chapter Secretary-Treasurer

THE SECOND ANNUAL PICNIC of Central Illinois chapter, June 21, was so successful a "Clam Bake" that officers and directors expect to duplicate that type of outing annually in the future.

Some 190 foundrymen and their guests came out for the day of fun and good fellowship.

Cincinnati District

E. F. Kindinger
Williams & Co.
Chapter Secretary

THE EIGHTH ANNUAL SPRING PARTY of Cincinnati District chapter, one of its biggest and most successful, was held at the Clovernook Country Club on June 17. Some 260 members and guests were present to wind up the chapter's 1947 season. The golf course was full from noon until dinner time, and the ground around the horse shoe stakes took a beating. There was baseball and other games and entertainment after dinner; and rain, which interrupted the ball game, failed to dampen the enthusiasm and enjoyment of the guests.

E. J. Kihn, Cincinnati Milling Machine Co., Chapter Vice-Chairman for the past season, has been elected *Chairman* for the coming year.

Named *Vice-Chairman* for 1947-48 is A. D. Barczak, Bardes Forge and Foundry Co., Cincinnati.

E. F. Kindinger, Williams & Co., Cincinnati, was reelected *Secretary;* C. S. Mold, Portsmouth Steel Corp., and W. A. Funk, Reliance Foundry Co., both of Cincinnati, *Treasurer* and *Assistant Treasurer,* respectively.

Chosen as *Directors* to serve for three years are J. D. Judge, Hamilton (Ohio) Foundry & Machine Co.; A. L. Grimm, Dayton (Ohio) Malleable Iron Co.; W. J. Klayer,

Gathered around the luncheon table above are seventeen A.F.A. members in Sao Paulo, Brazil. They recently held their first luncheon and met with such success and satisfaction that those present decided to hold similar luncheons every three months. Present at the first gathering were (seated, left to right) Ferrucio Bocciarelli, Instituto de Pesquizas Technologicas; Nicolau Filizola, Industrias Filizola S/A; Horace A. Hunnicut, International Nickel Co., Inc.; Miguel Siegel, Equipamentos Industriais "EISA" Ltda.; Joel Ramalho, Elevadores Atlas S/A; Paulo Ivany, MITEC-Industrias Brasileiras Mecanicas e Ferro Maleavel S/A and (standing left to right) Renato Reffineti, Gustavo Haenel of Instituto de Pesquizas Tenologicas; Mauricio Novinsky, COBRASMA-Cia. Brasileira de Material Ferroviario; Eugene Schultz; Carlos Teixeira and Martinho Prado Uchoa of Elevadores Atlas S/A; Jordao Vecchiatti, Equipamentos Industriais "EISA" Ltda.; Severio V. B. Labbate, Theodoro Niemeyer, Ernesto Diederichsen, all with Elevadores Atlas S/A; and Oswaldo Filizola, Industrias Filizola S/A.

Aluminum Industries, Cincinnati, and A. J. Smith, Lunkenheimer Co., Cincinnati.

Southern California

R. R. Haley
Advance Aluminum & Brass Co.
Chairman, Publicity Committee

TENTH ANNIVERSARY of the founding of Southern California chapter was celebrated at the June 13 meeting. Starting with a membership of 34, the group has become one of the largest in the Association, with 357 on its roster as of June 1.

Technical speaker of the evening was L. F. Miller, Osborn Mfg. Co., Cleveland, who serves as a director of Northeastern Ohio chapter.

Mechanized equipment in foundries, Mr. Miller told the group, places greater responsibility upon supervisory personnel. The installation of such facilities must be followed by proper use and maintenance, he pointed out.

Discussing core blowing techniques, the speaker placed particular emphasis on the importance of good core box rigging. Mixing of the sand with the right binders and for the proper intervals, was another aspect underlined as critical to good practice. Selection of the sand must be based upon the requirements of the job and the type of core to be blown, Mr. Miller said.

He expressed the opinion that blowing methods should be confined to cores. Molding machines using ram and squeeze methods are the most economical where heavy castings are produced with the use of green sand, the speaker said.

Central Indiana

J. W. Giddins
International Harvester Co.
Chapter Reporter

TECHNICAL TOPIC of the evening at Central Indiana chapter's final meeting of the season May 26 in the Athenæum, Indianapolis, was "Cores, Core Binders and Core Oils." J. A. Gitzen, Delta Oil Products Co., Milwaukee, was the speaker.

"Sand, water, binders, washes and proper baking, are the requisites to production of good cores," he told the foundrymen.

Discussing binders, Mr. Gitzen explained that, generally, the organic types are destroyed at approximately 1100 degrees F, changing to a gaseous state; while the inorganic are changed in form, but not in chemical analysis.

Cereal binders are used to give green strength, increase collapsibility and reduce drying time, the speaker said, adding that, as a whole, they produce more gas than oil binders. He listed corn, wheat, rye, potato and soya-bean flours, as cereals in common use, and noted

B. C. Yearley (center), National Malleable & Steel Castings Co., Chicago, explains a point to (left) Wm. Scott Roby and L. E. Roby, Peoria Malleable Castings Co., Peoria. Mr. Yearley spoke at the May 5 meeting of the A.F.A. Central Illinois chapter.

(Photo courtesy Caterpillar Tractor Co., Peoria)

that dextrin, starches, milk and vegetable proteins find occasional application as binders. Pitches, coal tar resins, rosin and a few of the newer plastics, are other popular binders mentioned by Mr. Gitzen.

Inorganic binders are not in general usage, according to the speaker.

J. A. Gitzen who was the technical speaker at the May meeting of the Central Indiana chapter.

This type of binder, which includes clays, oxides and silica flour, fuses at high temperatures to form slag and hold the sand together, it was explained.

"Linseed oil is the most widely used oil," Mr. Gitzen stated, "although petroleum oils are increasing in popularity. The average core oil is composed of linseed,rosin and thinner—usually coal or crankcase oil."

The speaker, who serves on the A.F.A. Sand Division Core Test Committee and is chairman of its sub-group on core washes and pastes, asserted that most foundries bake their cores not in the oven, but in the mold, and warned, "Incomplete baking results in oxidation of the oil when metal is poured into the mold, raising the temperature of metal in contact with the core and causing the core to burn up."

Mr. Gitzen's remarks were followed by an extended general discussion period. Minor Carpenter, International Harvester Co., Indianapolis, served as technical chairman.

Central Illinois

G. H. Rockwell
Caterpillar Tractor Co.
Chapter Secretary-Treasurer

"HIGHLIGHTS of Malleable Practice" proved a topic of interest to gray iron and non-ferrous, as well as malleable foundrymen at the May 5 meeting of Central Illinois chapter in the Jefferson Hotel, Peoria. B. C. Yearley, National Malleable & Steel Castings Co., Cicero, Ill., was the speaker.

Members and guests were particularly interested in Mr. Yearley's comparison of the characteristics of gray and malleable iron and steel. The speaker detailed the different properties of each metal in explaining proper malleable casting practices in regard to shrinkage allowances, pouring temperatures, gates, risers and other aspects.

At the annual business meeting the chapter named A. V. Martens, Pekin (Ill.) Foundry & Mfg. Co., the present Vice Chairman to serve as *Chairman* for the coming year.

F. W. Shipley, Caterpillar Tractor Co., Peoria, who has served as a Chapter Director since 1946, was the choice for *Vice-Chairman.*

G. H. Rockwell, Caterpillar Tractor Co., was re-elected *Secretary-Treasurer.* He served out the unexpired term of C. W. Wade.

Retiring Chapter Chairman Zigmond Madacey, Caterpillar Tractor Co., and J. M. McCarthy, Jr., South Side Foundry, Peoria, were elected to three-years terms as *Directors.*

Central Indiana

Robert Langsenkamp
Langsenkamp-Wheeler Brass Works
Chapter Secretary

ANNUAL BUSINESS MEETING of Central Indiana chapter was held April 7 at the Athenæum, Indianapolis.

William Ziegelmueller, Electric Steel Castings Co., Indianapolis, who served as Vice-Chairman for 1946-47, was chosen to head the group as *Chairman.*

(Continued on page 80)

Speakers' table at the May meeting of the Central Indiana chapter was made up of the following men (left to right): P. V. Faulk and Fred Kurtz, Electric Steel Casting Co., Indianapolis; Miner Carpenter, International Harvester Co., Indianapolis; guest speaker J. A. Gitzen, Delta Oil Products Co., Milwaukee; Chapter Chairman J. P. Lentz, International Harvester Co.; George Clark, Cummins Engine Co., Columbus; and William Ziegelmueller, Electric Steel Casting Co.

FOUNDRY FIRM FACTS

The foundry of **Crown Pipe & Castings Co.,** Jackson, Ohio, suffered extensive damage in a fire May 23.

American Foundry Co., Inc., Indianapolis, Ind., has announced plans for construction of a new foundry at Tibbs Ave. and West Morris Street. The plant would occupy 12 acres of a 35-acre plot and would produce some 500 tons of automotive castings per day. Plans call for building operations to begin as soon as permission is granted by local authorities and castings production to be under way before January 1.

Tennessee Products Corp., Nashville, has announced the change of its corporate name to **Tennessee Products & Chemical Corp.,** effective June 1, 1947.

Gem Foundry Co. has been established at Sixth Avenue and 13th Street, Birmingham, Ala., the quarters formerly occupied by **Dixie Bronze Foundry Co.,** which has moved to North Birmingham. E. S. Albritton is owner of the Gem firm, which will produce gray iron castings.

Southern Illinois Foundry Co. has begun construction of a new foundry plant at Carmi, Ill. Expected to be completed by October, the foundry will produce furnace parts, the company reports.

Salem Engineering Co. has established an office at 512 Sinclair Bldg., Fort Worth, Texas. Harris Pruitt, director of sales in the southwest for the firm, is in charge of the new office.

Electro Metallurgical Co., Niagara Falls, N. Y., has launched a dust-elimination project. Work has already begun on alterations expected to eliminate 75 per cent of dust emanating from the plant.

Andersen Engineering Co., Los Angeles, now covers the entire state of California for the dust and fume control and ventilating equipment of **Claude B. Schneible Co.,** Detroit. The Andersen firm has handled the line in the Los Angeles area since 1938.

Buckingham Products Co. has moved to new quarters at 14100 Fullerton Avenue, Detroit. The firm, which manufactures polishing and buffing compounds, will have double the producing area at the new plant.

Kaiser-Frazer Corp., Willow Run, Mich., has purchased the facilities of **Round Oak Co.** at Dowagiac, Mich. The plant will be operated as the **K-F Dowagiac Foundry Division,** and will manufacture gray iron castings for Kaiser-Frazer engines. Stove manufacturing works at Dowagiac will be sold or leased.

Allis-Chalmers Mfg. Co., Milwaukee, has announced a construction and expansion program for its Pittsburgh (Pa.) works. Productive capacity will be increased by 50 per cent. New buildings will be erected at Pittsburgh and at the New River plant.

Air Reduction Sales Co., New York, will build new oxygen plants at Decatur, Ill., and Baton Rouge, La., according to a recent announcement.

Fox Aluminum Foundry, 625 Fifth Ave. N. E., St. Cloud, Minn., was destroyed by fire April 15.

Officials of **Texas Foundries, Inc.,** Lufkin, were guest speakers recently before the Texas A & M college student members of the American Society of Mechanical Engineers and Management Engineers. J. O. Klein, vice president-secretary, discussed "The Use of Malleable;" Deal Reese, "Industrial Engineering," and Scott Sayers, "Personnel Work." Malcom Henley analyzed a number of problems raised by the school's metallurgical department and presented recommendations on process and control practices.

Phoenix Silica Co., Louisville, Ky., is reviving operations on molding sand pits at East View, Ky. The deposit of white silica sand, covering some 25 to 30 acres, was worked for more than 50 years before operations were suspended.

Radov Foundry, a new castings firm at Meadville, Pa., has begun operations. M. J. Radov is owner and Charles Williams superintendent.

A new ferrous and non-ferrous castings plant, **Mathieu & Sons Foundry Co.,** has been incorporated at Galien, Mich., by T. J. Mathieu of St. Joseph, Mich.

J. B. Ripley Brass Foundry, Windsor, Vt., has been licensed by **Ampco Metal, Inc.,** Milwaukee, to pour "Ampco" castings.

Daney Castings Co., Inc., Toledo, Ohio, has obtained a building permit for construction of foundry. The firm produces light metal castings.

American Radiator and Standard Sanitary Corp., Buffalo, N. Y., has launched an expansion program to which more than two million dollars may be diverted, plant officials have announced. Construction of a new warehouse will be one of the principal items of the program.

York Electro-Cast Corp., York, Pa., has announced an expansion of its line of pure copper castings scheduled for this month, when it will move into new quarters at Spry, Pa.

Empire Steel Corp., Mansfield, Ohio, has announced the near completion of a quarter-million-dollar boiler plant, and provision for construction of burner and oil storage tank facilities as a precaution against curtailment of natural gas supplies. According to a report of the board, the firm has provided more than eight hundred thousand dollars for capital improvements over the last eighteen months.

Kutztown Foundry & Machine Co., New York, recently broadened its employee group insurance program, to provide disability, hospitalization and surgical benefits for all eligible employees.

Eleven firms are represented in the new induction and dielectric heating apparatus section of the National Electrical Manufacturers Association. They are **Allis-Chalmers Mfg. Co.,** Milwaukee; **Cutler-Hammer, Inc.,** Milwaukee; **Federal Telephone & Radio Corp.,** Clifton, N. J.; **Girdler Corp.,** Louisville, Ky.; **Induction Heating Corp.,** New York; **Industrial Electronics Div., Westinghouse Electric Corp.,** Baltimore, Md.; **Industrial Heating Div., General Electric Co.,** Schenectady, N. Y.; **Lepel High Frequency Laboratories, Inc.,** New York; **RCA Victor Div., Radio Corp. of America,** Camden, N. J.; **Tocco Div., Ohio Crankshaft Co.,** Cleveland; and **Weltronic Co.,** Detroit.

Montague Castings Co., Tenth St. and Western Ave., Montague, Mich., has announced a change of firm name to Paul M. Wiener Foundry Co.

Frank L. Crobaugh Co., Cleveland, analytical chemists and metallurgists, has announced extension of its services to include foundry consulting. W. J. Bueche, formerly foundry metallurgist and assistant manager of foundries for National Tube Co., heads the new department, which will deal with cupola operation and general foundry problems.

General Alloys Co. has purchased the government-owned Boston plant it operated during the war. The facilities are used for production of steel, aluminum and magnesium castings.

Buffalo Pipe & Foundry Corp., Tonawanda, N. Y., has resumed production of soil pipe up to fifteen inches in diameter, following the lifting of government restrictions on July 1.

RESEARCH AND DEVELOPMENT *

INDUSTRIAL RESEARCH and development was given a great impetus during the war, and today that impetus is being maintained or in some cases expanded. Wise management is sold on investment for the future. Within the foundry industry the pace of industrial research and development has increased. While not on a par with some competitive products, it is nevertheless advancing steadily. Among the agencies which can promote more research and development are: individual firms, both large and small; trade associations, association of users, combinations of the two in large and small groups, and the over all metal castings industry associations and technical societies.

Research and development that is being sponsored within the foundry industry is classified broadly as follows:

1. Equipment manufacturing companies: Their research activities are devoted to the production of more efficient equipment and expanding uses of existing equipment. For example melting equipment, sand handling systems, dielectric drying of cores, and applications of indicating, controlling and recording accessories have been greatly improved.

2. Metal suppliers, both large and small: These firms are concerned with the development of high-production rates of high-quality metal and its use; the development of sources of various metals; and new alloys. Emphasis is being given to the study of high temperature resisting alloys and the development of continuous casting processes.

3. Molding materials producers: In this category are sand binder and coating developments, graphite core developments, metal molds and cores, phenolic resins and refractory ceramics in core and molding materials. A new field is exothermic feeding. Also improved refractories and methods of lining furnaces are being developed.

4. Testing equipment manufacturers: Their research and development deals with the manufacture of test equipment and the significance of tests in the foundry. Sand testing equipment development is well publicized. Other developments include rapid spectrographic analyses; electrolytic metallography work; crack and flaw detection by magnetic, supersonic, electric, and radiographic means; and physical property test equipment such as fatigue testing and high temperature strength testing.

5. Small specialty parts foundries: Their aim is directed toward foundry methods for improved quantity and quality. Examples of such developments are the precision or lost wax process casting methods, the permanent mold casting of cast iron, ladle inoculation practices, and pouring techniques studied by motion picture radiography.

6. The users of foundry products: These usually enter a cooperative research arrangement, by which the metallurgist of the user concern sets up the chemical and physical requirements of the foundry products he desires and presents them to the provider. Together they work out the details completely through service testing of products. The users of foundry products usually develop multi-metal combinations, composite fabrication practices, control practices, as well as continually pressing for better quality at lower costs from suppliers.

7. A miscellaneous group: For example, mathematicians who develop statistical and probability methods which are adapted to foundry practices; the air conditioning field which will permit development of alloys previously associated with noxious or objectionable fumes.

These research and development classifications were made to indicate which fields are being carefully canvassed, and by inference which fields are likely to be most fruitful for the average foundry to enter. The value of keeping abreast and participating in research and development for even the small business is being continuously proven in practice.

* Abstract of talk of the same title presented at a meeting of the A.F.A. Oregon chapter, by Harry Czyzewski, Metallurgical Engineers, Inc., Portland.

A.F.A. Board of Directors Approve Plans For More Student Chapters

INCREASED STUDENT and apprentice memberships in A.F.A. parallel the steady growth of the Association. As a result, the Board of Directors has established a policy to promote the formation of additional student chapters in schools which have shown particular interest. At present there is only one university student chapter, which was formed in 1941 at the University of Minnesota.

Student chapters of A.F.A. will be approved by the Board of Directors on the basis of a petition signed by no less than 15 students, according to the new policy.

Officers of Chapter

A Faculty Advisor and an Industrial Advisor must be included in the officers of the student chapter, the Industrial Advisor to be an A.F.A. member. In a regular chapter area he should be the chapter chairman or the chairman of the chapter educational committee. The entire amount of each student membership dues, $4 per year, will be refunded to the student chapter for financing. Expenditures will require the approval of the Faculty Advisor or as may be required under the rules of the college or school.

The chairman of each student chapter will be invited to the annual Chapter Chairman Conference on the same basis as regular chapter chairmen.

Full details for the information and operation of A.F.A. student chapters may be obtained from American Foundrymen's Association, 222 West Adams Street, Chicago 6, Illinois.

A.F.A. Board Holds Yearly Meeting

THE ANNUAL meeting of the A.F.A. Board of Directors was held in Chicago, Tuesday and Wednesday, July 29-30. The group was headed by retiring A.F.A. President S. V. Wood, Minneapolis Electric Steel Casting Co., Minneapolis and newly-elected A.F.A. President Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va. Complete details of this meeting will be reported in the September, AMERICAN FOUNDRYMAN.

✶ AUGUST WHO'S WHO ✶

E. H. Bankard

Alma mater for E. H. Bankard is Purdue University, Lafayette, Ind. . . . Second author this month who is a graduate of the Hoosier institution (See sketch of R. L. Orth) . . . Mr. Bankard graduated in 1931 and immediately became affiliated with Buick Motor Car Div., General Motors Corp., Flint, Mich. . . . He has held almost every position in the foundry during his 16 years of service with Buick . . . At present he is assistant foundry superintendent . . . Participates in the activities of the A.F.A. Saginaw Valley chapter, of which he is a director.

R. L. Orth

Abrasive cleaning is the subject of a paper published herein and written by R. L. Orth . . . A 1935 graduate of Purdue University, Lafayette, Ind., Mr. Orth received a Bachelor of Science degree in mechanical engineering . . . Joined the sales staff, American Foundry Equipment Co. (now American Wheelabrator & Equipment Corp.) Mishawaka, Ind., following his graduation . . . Was assigned to the Detroit office as sales engineer from 1939-45 . . . At present is Detroit district sales engineer . . . Member of A.F.A.

E. M. Cramer

The precision casting process has been the nature of a number of papers written by E. M. Cramer . . . In this issue he relates how aluminum impellers were made by means of precision casting . . . Hails from Colman, South Dakota . . . From the South Dakota State School of Mines and Technology, Rapid City, he was graduated with a Bachelor of Science degree (1938) . . . Later (1943) was awarded his Master of Science degree from the State College of Washington, Pullman . . . In 1938 was made analyst, The Canyon Corp., Deadwood, S.D. . . . For three years (1940-43) was junior research metallurgist, State College of Washington . . . At Long Beach, Calif., he was associated with Douglas Aircraft Corp., 1943-45, as metallurgist . . . Returned to State College in 1945 as metallurgist.

E. E. Ballard

The foundry engineering career of E. Eugene Ballard began in September, 1933, while associated with the St. Louis Frog & Switch Co., St. Louis, as chief engineer . . . This concern was part owner of Southern Manganese Steel Co. which is now operated by American Manganese Steel Div., American Brake Shoe Co. . . . In July, 1933, Mr. Ballard joined National Bearing Div., American Brake Shoe Co., St. Louis, as plant engineer . . . Last year became affiliated with Lester B. Knight & Associates, Inc., Chicago, as chief engineer, development and installation . . . A native Texan, he attended Texas A & M, College Station . . . Enrolled later at Armour Institute of Technology, Chicago . . . Prior to his castings experience, Mr. Ballard was a draftsman with Southwest Bell Telephone Co. and Missouri, Kansas and Texas Railroad, both of Dallas, from 1911-16 . . . Obtained further engineering knowledge while assistant engineer with the Atchison, Topeka and Sante Fe Railroad, Chicago, (1916-19) and the M.K. & T., Dallas, (1919-20) . . . Was appointed office engineer in St. Louis for the latter road during 1920-23 . . . A member of A.F.A. and contributes to this month's issue of AMERICAN FOUNDRYMAN an article relating to safety and hygiene in the foundry.

W. P. Sullivan

William P. Sullivan was the winner of the technical papers contest which was sponsored by the Eastern Canada & Newfoundland chapter during the past chapter season . . . He has been connected with the foundry industry since 1943 when during summer vacation he joined Warden King Ltd., Montreal . . . Mr. Sullivan was assigned to the metallurgical and sand laboratories during his sojourn with the company . . . After obtaining his Bachelor of Arts from Loyola College, Montreal, in 1945, he was appointed supervisor of the metal control department . . . The author also holds a teacher's degree from Jacques Cartier Normal School and a teacher's educational diploma from the University of Montreal . . . Has also attended metallurgical classes at McGill University . . . Member of A.F.A.

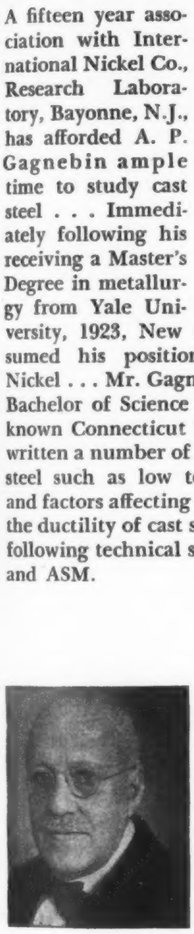
A. A. Clay

Cost control interests both the ferrous and non-ferrous foundryman, consequently the paper prepared by A. A. Clay should bear reading . . . Mr. Clay is a certified public accountant in New York, New Jersey and Ohio and received his degree from New York University . . . Is comptroller, Ohio Steel Foundry Co., Lima, and prior to that time was associated with a

number of accounting firms in New York and New Jersey . . . Has written extensively on cost control for the trade press and has spoken before a number of technical societies . . . Teaches accounting at Ohio Northern University . . . Each year when income taxes come due, Mr. Clay talks over WLOK, Lima, Ohio, and explains to the layman the old and new aspects of the law . . . A member of the Alloy Casting Institute, he is a cost advisor to the Shop Practice Committee . . . Is also an advisory member, district five, cost committee, Steel Founders Society of America.

A. P. Gagnebin

A fifteen year association with International Nickel Co., Research Laboratory, Bayonne, N.J., has afforded A. P. Gagnebin ample time to study cast steel . . . Immediately following his receiving a Master's Degree in metallurgy from Yale University, 1923, New Haven, Conn., he assumed his position with International Nickel . . . Mr. Gagnebin also obtained his Bachelor of Science degree from the well-known Connecticut university . . . He has written a number of articles relating to cast steel such as low temperature toughness and factors affecting the sulphide form and the ductility of cast steel . . . Belongs to the following technical societies: A.F.A. ASME and ASM.



E. B. Gallaher

E. B. Gallaher writes a monthly economic bulletin for the Army Ordnance Association and from his January 1947 publication comes the first of a two-part paper dealing with the intelligence of workers . . . It is said his articles on economics which appear in various publications, are reaching over 150,000 readers each month . . . The author has had a colorful career in the automotive industry and he has a collection of authentic photographs and newspaper clippings dating back 50 years and more describing his work in the development of the automobile . . . In 1903, he invented an entirely new, basic product, for which he obtained a patent, making it for use in his automobile plant . . . Mr. Gallaher retired in 1910, his automobile interests having been merged . . . He bought a farm and decided to devote his life to scientific research and business economics . . . However, the need for the product he planned to abandon grew and he built a factory, The Clover Mfg. Co., Norwalk, Conn., an organization he still owns and operates today.

A.F.A. CHAPTER DIRECTORY

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PERSONALITIES

(Continued from page 63)

Temperature Intervals Between Quenching and Aging of Aluminum Sand Casting Alloys," before meetings of two technical groups. He addressed the California chapters of American Institute of Mining and Metallurgical Engineers and Non-Ferrous Founders Society.

Alexander Carmichael, iron founder of Sydney, Australia, is spending a number of weeks in this country seeing American foundry methods, particularly as they concern operations of a small mechanized foundry, and visited the National Office recently.

J. B. Renard and **M. L. Jacquet** of Paris, France, were recent visitors to the A.F.A. National Office. They are in this country with a group of French engineers and industrialists making an inspection of American plants and methods. Mr. Renard, who joined the A.F.A. during the visit, is works manager for Japy Brothers, a firm manufacturing such products as typewriters, electric motors and clocks. Mr. Jacquet, formerly affiliated with Felt & Tarrant Mfg. Co., Chicago, and revisiting that city after an absence of 26 years, is now management consultant with French Westinghouse Air Brake Co.

Dr. M. M. Leighton, chief of the State Geological Survey, Urbana, Ill., was honored as a "distinguished alumnus" by the State University of Iowa, Iowa City, at its recent centennial celebration. He was cited for "his eminence in his chosen field . . . and contributions to the public welfare." Dr. Leighton received his B.A. degree from State University of Iowa in 1912, in which year he won the Lowden prize in geology, and his master of science there in 1913. He received his doctorate from the University of Chicago in 1916.

Obituaries

John C. Kennedy, vice-president and general manager, Kennedy Valve Mfg. Co., Elmira, N. Y., died recently at the age of 59. He had been works manager since 1919 and vice president since 1928. A native of Brooklyn, he was the son of Daniel Kennedy, who established the company there in 1877.

Christopher H. Bierbaum, 83, vice-president and consulting engineer in charge of research, Lumen Bearing Co., Buffalo, N. Y., died June 15.

Originator of phosphor nickel-bearing bronzes, on which he held patents, and a pioneer in the study of the corrosive effects of oxidized mineral lubricating oils, Mr. Bierbaum was also the inventor of the micro-character. The device is used to study the physical properties of constituents of metals. He has been with the Lumen firm since 1901.

CHAPTER ACTIVITIES

(Continued from page 73)

Chapter Director G. E. Clark, Cummins Engine Co., Columbus, was named the new *Vice-Chairman*.

J. W. Giddins, International Harvester Co., and P. V. Faulk, Electric Steel Castings Co., both of Indianapolis, were elected *Secretary* and *Treasurer*, respectively.

Named *Directors*, terms expiring in 1950, are retiring Chapter Chairman J. P. Lentz, International Harvester Co., Indianapolis; H. L. Crepps, Frank Foundries Corp., Muncie; C. B. Juday, Perfect Circle Co., New Castle, and Robert Langsenkamp, Langsenkamp - Wheeler Brass Works, Indianapolis.

Robert Coady, Hoosier Iron Works, Kokomo, was chosen to serve out the unexpired term of G. E. Clark as Chapter *Director*.

Tri-State

First annual business meeting of Tri-State chapter was held June 20 at the Flamingo Club, Tulsa, Okla.

R. W. Trimble, Bethlehem Supply Co., Tulsa, was named the first *Chairman* for a regular term. He has served in that capacity since the organization of the group.

Named *Vice-Chairman* is Dale Hall, Oklahoma Steel Castings Co., Tulsa.

C. B. Fisher of Enardo Foundry & Mfg. Co., was chosen *Secretary* and F. G. Lister, Chicago Pneumatic Tool Co., *Treasurer*. Both are of Tulsa.

Directors are: for one year, E. C. Graham, Acme Foundry & Machine Co., Blackwell, Okla., and C. H. Bentley, Webb Corp., Webb City, Mo.

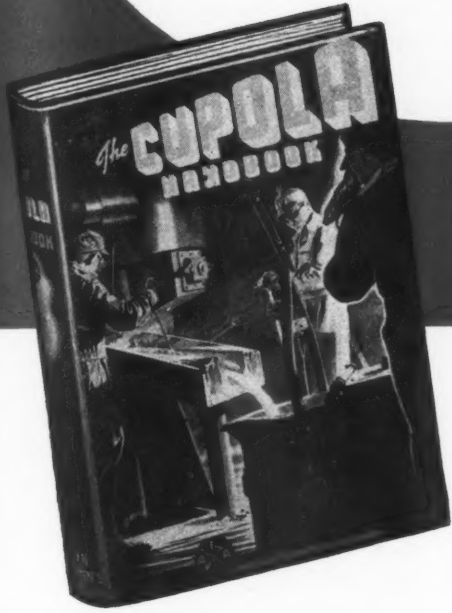
For two years, F. E. Fogg, Acme Foundry & Machine Co., Coffeyville, Kansas, and M. C. Helander, Enardo Foundry & Mfg. Co.

For three years, F. R. Westwood, Service Foundry Co., Wichita, Kansas, and B. P. Glover, M. A. Bell Co., Tulsa.

Two representatives of the chapter were named to serve on the A.F.A. Nominating Committee for 1948-49: C. H. Bentley and E. C. Graham.

(Continued on page 82)

Cupola OPERATIONS HANDBOOK



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CHAPTER ACTIVITIES

(Continued from page 80)

The June meeting was also the occasion of the first annual stag party of Tri-State chapter. Arrangements were handled by a committee headed by M. C. Helander.

A short business session was held following the dinner. C. A. McNamara, Jr., Big Four Foundry Co., Tulsa, interim secretary of the new chapter, cast the unanimous vote of the membership for the slate of officers and directors that had been presented at the May meeting. He also announced that chapter by-laws had been drawn up and approved.

Plans for the coming year were discussed and it was decided that a number of regular meetings will be held at other cities during the chapter season, to stimulate participation in the group and the interest of foundrymen in near localities.

The May meeting was held at the Hotel Mayo, Tulsa, the 23rd. Technical speaker was W. B. McFerrin, Electro Metallurgical Co., Detroit. The speaker, who is Vice-Chairman of the A.F.A. Malleable Division and Co-Chairman of the Gray Iron Division Analysis of Casting Defects Committee, presented a comprehensive discussion of "Casting Defects."

Members and guests followed Mr. McFerrin's remarks closely, and took part in a lively and interesting general discussion after the formal presentation. Anton Johnson, Oklahoma Steel Castings Co., served as technical chairman.

D. M. Avey, Avey Products Co., Tulsa, who served as A.F.A. President, 1934-36, attended his first meeting with the new chapter. He explained that he had been out of town and had been obliged to miss earlier meetings, but extended his best wishes for the success of the group and promised his support.

B. P. Glover, chairman of the chapter nominating committee, presented the recommendations.

Toledo

G. R. Rusk, Freeman Supply Co., Toledo, has been named *Chairman* of Toledo chapter for 1947-48. He was Vice-Chairman the past season, Secretary-Treasurer in 1945-46 and previously a director.

E. E. Thompson, Unitcast Corp.,

Toledo, Secretary-Treasurer for the past year, is the new *Vice-Chairman.* Elected *Secretary-Treasurer* is Rudy Van Hellen, Unitcast Corp.

Directors chosen for three-year terms are Frank Beierla, Clinton Pattern Works; Jay Moon, Freeman Supply Co., and B. L. Pickett, Unitcast Corp., retiring Chapter Chairman, all of Toledo.

One of the most entertaining coffee talkers to be presented before the Southern California, "Push 'em Up" Tony (below) rhymed the entire meeting of the chapter for the members up to the time he was introduced. (Bottom)—W. D. Emmett (left) hands the chapter gavel to H. E. Russill, Eld Metal Co., newly elected Southern California chapter chairman.

COMMITTEES MEET

Educational Division

Executive Committee Meeting

The meeting was opened with a proposed plan that the Engineering Schools Committee and the Industrial Training Committee be eliminated and that the present subcommittees become committees responsible directly to the Executive Committee. Chairmen of the two extinct committees become members-at-large on the Executive Committee and the chairmen of the present subcommittees become members of the Executive Committee.

It was also agreed upon that the Program and Papers Committee should consist of the vice-chairmen of all division committees.

The name of the Engineering Apprentice Training Committee was changed to Graduate Industrial Training Committee.

A discussion of the College Foundry Courses Committee was presented and among the activities planned by the committee are: (1) an advanced course for seniors, (2) an advanced course for graduate students, (3) an elementary foundry course for schools without foundry facilities, and (4) a foundry textbook for engineering schools.

A three-point program was presented concerning the activity of the Recruiting of Engineers Committee.

The program of the Foreman Training Committee was discussed and it was suggested that small foundries ought to band together to operate foreman training programs.

The tentative program for the 1948 convention was set up as follows: one educational session and a round table luncheon to be held on the same day.

Brass and Bronze *

Business Meeting

A REPORT was advanced by the Program and Papers Committee stating that a plan was already underway to procure 1948 convention papers and that three technical sessions and a roundtable luncheon were desired. Inasmuch as the Annual Lecture Committee reports that a series of five lectures on foundry control are being planned

* Officers elected for this division are reported in the June issue p. 48.

for 1948, it was suggested that the program and papers committee chairman might coordinate the brass and bronze foundry control lecture with the divisional technical sessions.

The present status of the Research Committee was reviewed and it was stated that the committee was interested in the study of the fracture test, and its application to brass and bronze foundry control because of its universal application and its practicability. Fracture tests were discussed and it was pointed out that there was need for additional correlation of fracture with mechanical and physical properties and various chemical, metallographic and spectrographic methods of examination.

It was also reported that revision of the book on recommended practices is under consideration.

Precision Investment Casting Process Committee

The tentative draft of the general technique for low-temperature investments were reviewed and some minor changes were made. Work also has begun on the general technique for high-temperature investments. An outline giving the accepted procedure for testing investments were distributed to the committee members.

Sand *

Business Meeting

A report was received from the Core Test Committee reviewing the work accomplished, during the year.

Next on the agenda was a resume in connection with the development of secondary standard sand. Specifications for this sand were read to those present.

The use of the 325 mesh sieve for separating clay from sand grains was outlined. The purpose of the sieve is to make a separation at 20 microns.

Also mentioned was the use of a rubber covered pestle to remove clay from sand grains before testing.

To be reactivated this year is the Mold Surface Committee; several projects are under consideration.

* Officers elected for this division are reported in the June issue p. 48.

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